PB82-158023

Reno-Sparks Joint Water Pollution Control Plant
Cross-Town Sewer and Lawton-Verdi Interceptor
Extension: Draft Environmental Impact
Statement and Addenda

Reno, NV

Prepared for

Environmental Protection Agency
San Francisco, CA

Jan 77

U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. Recipient's Accession No. PB82 158023
4. Title and Subtitle Draft E.I.S. Reno-Sparks Joint Water Pollution Control Plant Cross-Town Sewer & Lawton-Verdi Interceptor Extension and Addenda			5. Report Date January 1977
			6. 032061
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization Name and Address U.S. Environmental Protection Agency Region IX San Francisco, CA 94111			10. Project/Task/Work Unit No.
			11. Contract(C) or Grant(G) No. (C) C-32-0114-10 (G)
12. Sponsoring Organization Name and Address Same as box 9.			13. Type of Report & Period Covered Environmental impact statement
			14.

15. Supplementary Notes

Prepared jointly with the City of Teno. Technical assistance by Truckee Meadows Engineers, Inc.

16. Abstract (Limit: 200 words)

The purpose of this EIS/EA is to: identify, analyze and assess the environmental benefits and impacts of alternatives to wastewater collection, transport, treatment, reclamation/reuse, and disposal systems for the project area, and to publicly present all issues surrounding the project's objectives including the primary and secondary benefits and impacts so that they may be considered and resolved as openly and satisfactorly as possible

The project is located in a semiarid portion of the Truckee River Basin. The Major public concerns with respect to water related issues focus on water quality, water quantity and ultimate effluent disposition for the area.

The Addenda reviews the existing environment and project alternatives and their impacts.

Sand includes Reno and Sparks, Nevada

17. Document Analysis a. Descriptors

Sewerage
Regional Planning
Nevada
Treatment Facilities
Interceptor Sewers
Wastewater Treatment

b. Identifiers/Open-Ended Terms

Secondary Effects
Reno, Nevada
Sparks, Nevada
~~Truckee River~~
Truckee River
Environmental Impact Statement
Pyramid Lake

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
	20. Security Class (This Page)	22. Price

(See ANSI-Z39.18) See Instructions on Reverse OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

EPA-9-NV-WASHOE-RENO/
SPARKS-WWTP/INT-TR

PB82-158023

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND ADDENDA

RENO-SPARKS JOINT WATER POLLUTION CONTROL PLANT CROSS-TOWN SEWER & LAWTON-VERDI INTERCEPTOR EXTENSION

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

C-32-0114-010

DRAFT
ENVIRONMENTAL IMPACT STATEMENT & ENVIRONMENTAL IMPACT ASSESSMENT FOR
reno-sparks joint water pollution control plant, cross-town sewer and lawton-verdi interceptor extension
january 1977

Paul DeFalco Jr.
Regional Administrator
Region IX

Carl Bogart
Mayor
City of Reno

U.S. ENVIRONMENTAL
PROTECTION AGENCY
Region IX
100 California St.
San Francisco, CA. 94111

CITY of RENO
P.O. Box 1900
Reno, NV. 89505

Technical Assistance By:

TRUCKEE MEADOWS ENGINEERS, Inc.
Reno, Nevada

TABLE OF CONTENTS

	Page No.
Title Page	i
Table of Contents	iii
List of Tables	xiii
List of Figures	xx
Letter of Transmittal	xxvii
Preface	xxix
DRAFT ENVIRONMENTAL IMPACT STATEMENT	1-1
INTRODUCTION	1-1
Grant Applicants	1-1
Authority for Study	1-1
EIS Criteria	1-2
EIS Process	1-2
BACKGROUND	
Description of Study Area	1-3
Water Quality Problems in the Area	1-3
Planning Basis for Grant Applicants	1-6
Water Quality Planning in the Area	1-6
Water Quality Objectives	1-7
Related Planning Efforts	1-8
PROJECT BACKGROUND AND DESCRIPTION OF VIABLE ALTERNATIVES	1-9
History of Project	1-9
Reno-Sparks Joint Water Pollution Control Plant Expansion Alternatives	1-10
Cross-Town Sewer and Lawton-Verdi Interceptor Alternatives	1-13
SUMMARY ENVIRONMENTAL IMPACT EVALUATION OF VIABLE PROJECT ALTERNATIVES	1-24
Methodology	1-24
Environmental Goals and Constraints	1-24
Minimal Regional Secondary Impacts	1-25
Significant Regional Secondary Impacts	1-26
Site Environs Impacts of the Treatment Plant Expansion	1-32

TABLE OF CONTENTS
(Continued)

		Page No.
	Lower Truckee River, Pyramid Lake Basin and Spanish Springs Impacts	1-36
	Cross-Town Sewer Extension Corridor Impacts	1-39
	Lawton-Verdi Interceptor Corridor Impacts	1-42
	DISCUSSION AND EVALUATION OF ALTERNATIVE DESIGN CAPACITIES	1-46
	POSSIBLE MITIGATIVE MEASURES	1-48
	Primary Project Mitigative Measures	1-48
	Secondary Impact Mitigative Measures	1-54
	PROBABLE SIGNIFICANT ADVERSE IMPACTS WHICH CANNOT OR ARE NOT CURRENTLY PROPOSED TO BE MITIGATED	1-58
	RELATIONSHIP BETWEEN LOCAL SHORT TERM USES AND LONG TERM PRODUCTIVITY OF THE ENVIRONMENT	1-61
	IRREVERSIBLE, IRRETRIEVABLE COMMITMENT OF RESOURCES	1-62
	PUBLIC CONCERNS AND UNRESOLVED ISSUES	1-63
ADDENDA		
Chapter No.		
II	EXISTING ENVIRONMENT	2-1
	INTRODUCTION	2-1
	General Physical Characteristics	2-5
	Regional Location	2-5
	Topology/Hydrology of the Truckee River Basin	2-5
	Service Area Topology/Hydrology	2-7
	Specific Site Locations	2-8
	SCENIC, RECREATIONAL AND CLIMATIC VALUES	2-9
	Introduction	2-9
	Regional Environment	2-9
	Area Environment	2-10
	Specific Site Environments	2-11
	Recreation Setting	2-11
	Climate	2-17

TABLE OF CONTENTS
(Continued)

	Page No.
HISTORIC AND ARCHAEOLOGICAL RESOURCES	2-23
Introduction	2-23
Early Indians	2-23
Trappers and Explorers	2-24
Coming of the Railroads	2-25
Legalized Gaming and Urban Development	2-26
Archaeological Methodology	2-27
Archaeologic Findings	2-28
SOILS AND GEOLOGY	2-32
Regional Setting: Geology and Seismicity	2-32
Rgional Setting: Soils and Minerals	2-35
Service Area Setting: Geologic Units and Faults	2-38
Soils of the Service Area	2-42
Geologic Hazards of the Service Area	2-47
Interceptor Routes: Soils and Geology	2-51
Treatment Plant Site: Soils and Geology	2-52
Spanish Springs Valley Disposal Site: Soils and Geology	2-52
Transmission Pipeline Route: Soils and Geology	2-53
FLORA AND FAUNA	2-53
Vegetation	2-53
Terrestrial Fauna	2-61
Aquatic Fauna	2-69
Rare and Endangered Species	2-83
AIR QUALITY AND NOISE	2-85
Air Quality	2-85
Acoustics	2-118
URBAN SYSTEMS	2-118
Transportation and Circulation	2-118
Utilities Other Than Waste-water and Water Supply	2-133
Energy Supply/Demand	2-134

TABLE OF CONTENTS
(Continued)

		Page No.
III	LOWER TRUCKEE RIVER - PYRAMID LAKE BASIN SYSTEM	3-1
	INTRODUCTION	3-1
	WATER RIGHTS HISTORY	3-2
	WATER USE SUMMARY	3-5
	Irrigation	3-5
	Public Supply	3-5
	Self-Supplied Industry	3-6
	Power Generation	3-6
	Rural Uses	3-6
	Interbasin Transfers	3-6
	SURFACE WATER HYDROLOGY	3-7
	Lake Tahoe	3-10
	Truckee River	3-12
	Truckee Meadows	3-14
	Pyramid Lake	3-16
	GROUNDWATER HYDROLOGY	3-18
	Truckee Meadows	3-18
	Spanish Springs Valley	3-25
	SURFACE WATER QUALITY	3-29
	Evolution of Water Quality Policy	3-29
	Water Quality Standards	3-31
	Water Quality Data	3-34
	Future Water Quality Objectives	3-50
	EXISTING REGIONAL SEWERAGE FACILITIES	3-53
	Reno-Sparks JWPCP	3-53
	Sewage, Flows and Loading	3-59
	Existing Sewer Service Areas and Trunks	3-60
	Infiltration/Inflow Quantities	3-69
	Reclamation and Reuse Potential	3-71
	Existing Local Self-Contained Sewerage Systems	3-71

TABLE OF CONTENTS
(Continued)

		Page No.
IV	URBANIZATION OF THE SERVICE AREA	4-1
	INTRODUCTION	4-1
	GROWTH PATTERNS	4-2
	Overview	4-2
	LAND USE PLANNING	4-6
	On-Going Process	4-6
	Forecasted Land Use	4-8
	Land Use Constraints	4-12
	DEMOGRAPHICS	4-15
	Existing and Historic Population	4-15
	Racial Mixture	4-18
	Constraints on Future Population	4-18
	Population Distribution	4-26
	Housing	4-30
	Economic Conditions	4-35
V	PROJECT ALTERNATIVES	5-1
	INTRODUCTION	5-1
	Wastewater Treatment	5-1
	Interceptor Sewer Projects	5-2
	DESCRIPTION OF ALTERNATIVES	5-5
	The Lawton-Verdi Interceptor Sewer (Numbered Alternates)	5-5
	The Cross-Town Sewer (Lettered Alternates)	5-6
	Sewage Treatment Plant Expansion Alternatives	5-7
	CONSTRAINTS ON CONSIDERATION OF ALTERNATIVES	5-12
	Wastewater Treatment	5-13
	SCREENING OF ALTERNATIVES	5-18
	The Lawton-Verdi Interceptor Routes	5-18
	The Cross-Town Sewer Routes	5-19
	Wastewater Treatment/Sludge Handling Concepts	5-22
	Conceptual Matrix	5-23
	OVERVIEW OF WASTEWATER TREATMENT/SLUDGE HANDLING CONCEPTS	5-40

TABLE OF CONTENTS
(Continued)

		Page No.
	No Action Alternative	5-40
	Action Alternative Concepts Effects	5-40
	OVERVIEW OF SEWER LINE ALTERNATES	5-44
	No Action Alternate	5-44
	Route Descriptions for Final Evaluations	5-44
	Action Alternate Effects	5-50
VI	IMPACTS OF THE PROPOSED ACTIONS	6-1
	INTRODUCTION	6-1
	Chapter Format	6-1
	Impact Description	6-1
	Environmentally Sensitive Issues	6-2
	IMPACTS AT REGIONAL SCALE - FACTORS REFLECTING LITTLE OR NO PROJECT IMPACT	6-3
	Topography	6-3
	Scenic and Aesthetic Characteristics	6-4
	Climate	6-5
	Recreation	6-5
	Drainage and Flood Control	6-6
	Acoustics	6-7
	Groundwater Hydrology/Quality	6-8
	Water Use and Downstream Flow Quantity	6-8
	IMPACTS AT REGIONAL SCALE - FACTORS REFLECTING PRIMARY PROJECT IMPACT	6-11
	Surface Water Quality	6-11
	IMPACTS AT REGIONAL SCALE - FACTORS REFLECTING SECONDARY PROJECT IMPACTS	6-12
	Demographics	6-12
	Land Use and Urbanization	6-18
	Urban Systems	6-26
	Flora and Fauna	6-38
	Air Quality	6-40

TABLE OF CONTENTS
(Continued)

	Page No.
IMPACTS OF TREATMENT PLANT ALTERNATIVES ON THE SITE ENVIRONS	6-57
Topography	6-57
Scenic and Aesthetic Characteristics	6-57
Archaeologic Resources	6-58
Soils, Geology and Seismicity	6-59
Climate and Air Quality	6-60
Acoustics	6-62
Urban Systems	6-62
Economics and Employment	6-67
IMPACTS OF TREATMENT PLANT ALTERNATIVES ON THE RELATED ENVIRONS (LOWER TRUCKEE RIVER, PYRAMID LAKE, SPANISH SPRINGS VALLEY)	2-70
Surface Water Hydrology - Concepts I and III	2-70
Surface Water Hydrology - Concepts II and IV	6-73
Surface Water Hydrology - No Project	6-75
Surface Water Quality - Concepts I, II, III and IV	6-75
Surface Water Quality - No Project	6-80
Flora and Fauna - Concepts I and III	6-81
Flora and Fauna - Concepts II and IV	6-85
Flora and Fauna - No Project	6-86
Recreation	6-88
Groundwater Hydrology/ Quality - Concepts I and III	6-88
Groundwater Hydrology/ Quality - Concepts II, IV and No Project	6-96
Comparison of Treatment Concept Impacts	6-96
Secondary Impacts of No Treatment Plant Expansion	6-96

TABLE OF CONTENTS
(Continued)

	Page No.
IMPACTS OF CROSS-TOWN SEWER ALTERNATIVES ON THE ROUTE ENVIRONS	6-111
Topography	6-111
Scenic and Aesthetic Characteristics	6-111
Recreation	6-112
Archaeologic Resources	6-113
Soils, Geology and Seismicity	6-113
Hydrology/Water Quality	6-114
Flora and Fauna	6-115
Climate and Air Quality	6-116
Acoustics	6-116
Land Use	6-116
Urban Systems	6-117
Economics	6-119
COMPARISON OF IMPACTS: CROSS-TOWN SEWER ALTERNATIVES	6-121
IMPACTS OF NO CROSS-TOWN SEWER PROJECT	6-121
IMPACTS OF LAWTON-VERDI SEWER RIVER ROUTE ON THE SITE ENVIRONS	6-132
Topography	6-132
Scenic and Aesthetic Characteristics	6-132
Recreation	6-132
Archaeologic Resources	6-133
Soils, Geology and Seismicity	6-133
Hydrology/Water Quality	6-135
Flora and Fauna	6-135
Air Quality	6-136
Acoustics	6-136
Urban Systems	6-136
Existing Regional Sewerage Facilities	6-137
Land Use	6-137
Economics	6-137

TABLE OF CONTENTS
(Continued)

		Page No.
	IMPACTS OF LAWTON-VERDI SEWER RAILROAD ROUTE ON THE ROUTE ENVIRONS	6-138
	Topography	6-138
	Scenic and Aesthetic Characteristics	6-138
	Recreation	6-138
	Archaeology	6-139
	Soils, Geology, Seismicity	6-139
	Hydrology/Water Quality	6-139
	Flora and Fauna	6-139
	Air Quality	6-139
	Acoustics	6-140
	Urban Systems	6-140
	Existing Regional Sewerage Facilities	6-140
	Land Use	6-140
	Economics	6-141
	COMPARISON OF IMPACTS FOR THE LAWTON-VERDI SEWER ALTERNATES	6-141
	IMPACTS OF NO LAWTON-VERDI SEWER PROJECT	6-145
	MOST VIABLE PROJECT ALTERNATIVE	6-149
	Cross-Town Sewer	6-149
	Expansion of the JWPCP	6-150
	Lawton-Verdi Sewer	6-152
VII	UNAVOIDABLE ADVERSE IMPACTS AND MITIGATING MEASURES	7-1
	CONSTRUCTION	7-1
	OPERATION	7-2
	SECONDARY IMPACTS	7-6
	IMPLEMENTATION OF MITIGATIVE MEASURES	7-10
VIII	LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY	8-1

TABLE OF CONTENTS
(Continued)

		Page No.
IX	IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES	9-1
	CONSTRUCTION-RELATED RESOURCE CONSUMPTION	9-1
	Joint Water Pollution Control Plant	9-1
	Cross-Town Sewer (Mill Street Interceptor Extension)	9-2
	Lawton-Verdi Interceptor	9-2
	OPERATION-RELATED RESOURCE CONSUMPTION	9-3
SELECTED PROJECT		10-1
PUBLIC INPUT AND RESPONSE		11-1
APPENDICES		A-1
BIBLIOGRAPHY		B-1

LIST OF TABLES

Table No.		Page No.
2-A	Drainage Areas	2-8
2-B	Total Visitor-Days Attendance at Recreation Sites for Residents and Nonresidents by County, 1970	2-13
2-C	Total Visitor-Days Attendance at Recreation Sites for Residents and Nonresidents by Hydrographic Regions, 1970	2-14
2-D	1970 Recreational Visits by Site Type	2-15
2-E	Averages of Various Categories of Costs by Distance Zones	2-16
2-F	Selected Climatic Data	2-18
2-G	Temperature and Precipitation: Normals, Means and Extremes, Reno, Nevada	2-19
2-H	Additional Climatic Data: Normals, Means and Extremes, Reno, Nevada	2-20
2-I	Annual Average Frequency of Various-Sized Storms at Reno, Nevada	2-21
2-J	Soil Units	2-37
2-K	Modified-Mercalli Intensity Scale of 1931	2-49
2-L	A Summary of Phytoplankton Analysis of Truckee River Sampling Near Nixon, Nevada	2-70
2-M	Lower Truckee River Benthic Macro-invertebrate Dominant Order, Family and Genus - 1973	2-74

LIST OF TABLES
(Continued)

Table No.		Page No.
2-N	Lower Truckee River Benthic Macro-invertebrate Dominant Order, Family and Genus - 1974	2-75
2-O	Fish Stocking Data Truckee River and Pyramid Lake 1972 and 1975	2-78
2-P	Endangered Species - Lower Truckee River Basin	2-84
2-Q	Federal Air Quality Standards	2-87
2-R	Monitoring Methodology - Washoe County Health Department	2-97
2-S	Monitoring Methodology - Truckee Meadows Basin Air Quality Study	2-100
2-T	Sources of Pollutants Emitted in Washoe County - 1973	2-106
2-U	Sources of Particulates and Dust, 1975	2-108
2-V	Mobile and Stationary Sources of Air Pollutants - 1973 - Washoe County	2-111
2-W	Mean Mixing Heights and Wind Speeds at Reno, Nevada	2-115
2-X	Service Area Noise Samples	2-119
2-Y	Traffic Volumes of Major Streets in Reno Service Area - 1974-1975	2-130
2-Z	Traffic Volumes of Major Streets in Downtown Reno - 1974-1975	2-132
2-AA	Electric Revenue by Classes, Sierra Pacific Power Company 1964-1974	2-135

LIST OF TABLES
(Continued)

Table No.		Page No.
2-BB	Electrical Residential Customer Data per Average Customer, Sierra Pacific Power Company 1964-1974	2-136
2-CC	Gas Revenues by Classes, Sierra Pacific Power Company 1964-1974	2-137
2-DD	Gas Residential and Space Heating Customer Data per Average Customer, Sierra Pacific Power Company 1964-1974	2-138
3-A	Truckee River Minimum Flow at California-Nevada State Line	3-4
3-B	Groundwater Budget Information for the Truckee Meadows Area	3-26
3-C	Chemical Analyses of Water from Wells in Spanish Springs Valley	3-30
3-D	1973 Water Quality Standards, Truckee River	3-32
3-E	Stream Standards for Steamboat Creek	3-35
3-F	Truckee River Water Quality	3-37
3-G	Extreme Water Quality Values	3-39
3-H	Steamboat Creek Water Quality, February 1974	3-48
3-I	Water Quality in Steamboat Creek Near Confluence with the Truckee River	3-49
3-J	Water Quality in Pyramid Lake	3-51

LIST OF TABLES
(Continued)

Table No.		Page No.
3-K	Water Quality Analysis of Pyramid Lake	3-52
3-L	NPDES Permit Discharge Requirements	3-58
3-M	Wastewater Characteristics	3-59
3-N	Service Areas	3-61
3-O	1974 Cross-Town Sewer Flows	3-65
3-P	Existing Local Sewerage Systems	3-73
3-Q	Distribution of Persons not Served by Regional Treatment Facility	3-72
4-A	Gross Land Distribution as Shown in Adopted General Plans	4-9
4-B	Historic Population 1910-1975	4-17
4-C	Demographics	4-21
4-D	Forecasted Population: Ultimate Service Area, Population and Population Tributary to Reno-Sparks JWPCP	4-24
4-E	Geographic Aggregation of Census Tracts and Traffic Zones	4-31
4-F	Type of Residential Structures Constructed, 1970-1974	4-32
4-G	Service Area Housing Needs	4-34
4-H	Annual Changes in Dwelling Units	4-35
4-I	State of Nevada Employment by Industrial Classification	4-37

LIST OF TABLES
(Continued)

Table No.		Page No.
4-J	Washoe County Employment Distribution	4-39
4-K	Washoe County/Statewide Employment Distribution	4-45
4-L	Job Applicants and Openings Reno Area, 3rd Quarter 1975	4-48
4-M	Forecasted Nevada Employment Distribution	4-51
4-N	Forecasted Washoe County Employment Distribution	4-53
5-A	Incremental Plant Expansion	5-16
5-B	Initial Screening Matrix for the Lawton-Verdi Interceptor Sewer Routes	5-20
5-C	Initial Screening Matrix for the Cross-Town Sewer Routes	5-21
5-D	Operating Requirements and Effluent Parameters for the No Action Alternative	5-26
5-E	Operating Requirements, Effluent Parameters and Costs for Concept I	5-28
5-F	Operating Requirements, Effluent Parameters and Costs for Concept II	5-31
5-G	Operating Requirements, Effluent Parameters and Costs for Concept III	5-34
5-H	Operating Requirements, Effluent Parameters and Costs for Concept IV	5-37
6-A	Traffic Noise	6-7
6-B	Truckee Meadows Estimated Water Budget	6-10

LIST OF TABLES
(Continued)

Table No.		Page No.
6-C	Distribution of Population by Sewer Service Zone	6-14
6-D	Percent Distribution and Total Employment, Washoe County and State of Nevada	6-17
6-E	Metropolitan Truckee Meadows Generated Land Development-Usage Distribution According to Reno General Plan	6-21
6-F	West Reno-Lawton-Verdi Generated Land Development	6-23
6-G	Lawton-Verdi Area Vehicle Generation	6-28
6-H	Public Safety Workers	6-33
6-I	Distribution of Future Electrical Demand	6-36
6-J	Electrical Supply Sources	6-36
6-K	Electric and Gas Rates, 1974, Sierra Pacific Power Company	6-39
6-L	Distribution of Future Gas Demand	6-39
6-M	Economic Comparison of Alternate Concepts	6-68
6-N	Concepts I and III: Allocation of Plant Effluent	6-71
6-O	Concepts II and IV: Allocation of Plant Effluent	6-74
6-P	Recommended Application Rates for Digested Sludge	6-90

LIST OF TABLES
(Continued)

Table No.		Page No.
6-Q	Estimated Nutrient Loading Rates - Alternatives F, G and H	6-91
6-R	Digested Sludge Sample Analysis and Recommended Maximum Concentrations of Selected Metals for Land Application	6-93
6-S	Direct Impacts of Treatment Concepts - Summary	6-97
6-T	Secondary Impacts of No Treatment Plant Expansion - Summary	6-109
6-U	Direct Impacts of Cross-Town Sewer Alternatives - Summary Comparison	6-122
6-V	Cross-Town Sewer No Project Alternative - Summary of Impacts	6-128
6-W	Direct Impacts of Lawton-Verdi Alternatives - Summary	6-142
6-X	Impacts of No Project for the Lawton-Verdi Interceptor - Summary	6-146
7-A	Comparative Water Use Statistics	7-7
7-B	Control Techniques for Fugitive Dust Sources	7-16
7-C	Possible Control Strategies for Reduction of Emissions Related to Automobile Operations	7-17
8-A	Comparison of Short Term and Long Term Effects	8-2

LIST OF FIGURES

Figure No.		Page No.
1-1	Regional Map	1-4
1-2	Conceptual Matrix Treatment/Sludge Handling Alternatives	1-11
1-3	Cross-Town Interceptor, Alternate AB	1-15
1-4	Cross-Town Interceptor, Alternate CD	1-17
1-5	Lawton-Verdi Interceptor Alternates	1-21
2-1	Regional Map	2-2
2-2	Service Area Map	2-3
2-3	Regional Geologic Map, Project Service Area	2-33
2-4	Earthquake Epicenter Map (Richter Scale)	2-36
2-5	Geologic Map, Project Service Area	2-39
2-6	Geologic Hazards Map, Project Service Area	2-43
2-7	Soil Map, Project Service Area	2-45
2-8	Benthos Diversity in August 1967 Samples	2-72
2-9	Benthic Macroinvertebrate Population Fluctuations in the Lower Truckee River 1973-1975	2-76
2-10	Comparison of Carbon Monoxide Concentrations at Reno (Evans and Plaza Steets) With National Primary Standards	2-88

LIST OF FIGURES
(Continued)

Figure No.		Page No.
2-11	Comparison of Suspended Particulate Concentrations With National Primary Standards (Washoe County District Health Department Monitoring Stations)	2-89
2-12	Comparison of Nitrogen Dioxide Concentrations at Reno (Evans and Plaza Streets) With National Primary Standards	2-90
2-13	Comparison of Total Oxidant Concentrations at Reno (Evans and Plaza Streets) With National Primary Standards	2-91
2-14	Total Hydrocarbon Concentrations at Reno (Evans and Plaza Steets)	2-92
2-15	Air Quality Monitoring Sites Washoe County District Health Department	2-93
2-16	Mesoscale Air Quality and Meteorology Monitoring Sites Truckee Meadows Basin Air Quality Study	2-95
2-17	Location of Microscale CO Measurement Sites B1 through B18, Truckee Meadows Basin Air Quality Study	2-96
2-18	Location of Northwest Nevada Air Quality Maintenance Area	2-102
2-19	Emissions Inventory Boundaries	2-109
2-20	Surface Wind Roses at Reno International Airport	2-113
2-21	Occurrences of "Medium" to "Heavy" Air Pollution Levels	2-116

LIST OF FIGURES
(Continued)

Figure No.		Page No.
2-22	Noise Sample Locations	
	(2-22-A)	2-121
	(2-22-B)	2-123
2-23	Outdoor Day-Night Sound Level in dB (re 20 micropascals) at Various Locations	2-125
2-24	Road Network A.D.T.	2-127
3-1	Truckee River Basin	3-8
3-2	Annual Variation in Stage of Lake Tahoe	3-11
3-3	Historical Flow Averages in Truckee River Basin	3-13
3-4	Annual Streamflow at Gauging Station on Truckee River at Farad, CA	3-15
3-5	Water Budget for Truckee Meadows	3-17
3-6	Water Surface Fluctuations of Pyramid Lake	3-19
3-7	Approximate Water Table and Locations of Groundwater Discharge Areas - Truckee Meadows Area	3-21
3-8	Groundwater Quality of Truckee Meadows	3-23
3-9	Groundwater Hydrology - Spanish Springs Valley	3-28
3-10	Temperature	3-41
3-11	Dissolved Oxygen	3-42
3-12	Nitrates	3-43

LIST OF FIGURES
(Continued)

Figure No.		Page No.
3-13	Total Phosphates	3-44
3-14	Total Dissolved Solids	3-46
3-15	Expansion of Reno-Sparks JWPCP Regional Service Area	3-54
3-16	Schematic Diagram, Reno-Sparks JWPCP	3-56
3-17	Existing Area Served by JWPCP, Local Treatment Plants, Existing Interceptor System	3-63
4-1	Service Area Land Use	4-3
4-2	Historic Population	4-16
4-3	Regional Groupings of Census Tracts	4-19
4-4	Truckee Meadows Ultimate Sewer Service Zones	4-27
4-5	Historic and Forecasted Population	4-29
4-6	Historic Nevada Employment Distribution	4-38
4-7	Historic Washoe County Employment Distribution	4-40
4-8	Number of Firms and Number of Employees, Reno SMSA, 1974, by Industrial Classification	4-42
4-9	Yearly Average Decennial Rate of Change of Nevada Employment by Industrial Classification	4-43
4-10	Yearly Average Decennial Rate of Change of Washoe County Employment by Industrial Classification	4-44

LIST OF FIGURES
(Continued)

Figure No.		Page No.
4-11	Percent of all Nevada Employees in Washoe County by Industrial Classification	4-46
4-12	Annual Average and Seasonally Adjusted Unemployment (Labor Force)	4-49
4-13	Forecasted Nevada Employment Distribution	4-52
4-14	Forecasted Washoe County Employment Distribution	4-14
4-15	Population and Employees, Washoe County	4-55
5-1	Proposed Mill Street Interceptor Extension, Cross-Town Sewer	5-3
5-2	Alternatives Formulated by Kennedy Engineers, Inc. for Reno-Sparks 201 Facilities Plan	5-24
5-3	Conceptual Matrix Treatment/Sludge Handling Alternatives	5-25
5-4	Lawton-Verdi Interceptor Alternates	5-47
5-5	Cross-Town Interceptor Alternate AB	5-51
5-6	Cross-Town Interceptor Alternate CD	5-53
6-1	Peak Load and System Capability, 1964-1985	6-37
6-2	1975 Particulate Loadings and Projected Loadings - Full Growth	6-42
6-3	1973 Carbon Monoxide Loadings and Projected Loadings - Full Growth	6-44

LIST OF FIGURES
(Continued)

Figure No.		Page No.
6-4	1973 Hydrocarbon Emissions and Projected Loadings - Full Growth	6-47
6-5	1973 Nitrogen Loadings and Projected Loadings - Full Growth	6-49
6-6	Particulate and Dust Emissions - No Action Alternative	6-53
6-7	Nitrogen Oxide Loadings - No Action Alternative	6-54
6-8	Hydrocarbon Loadings - No Action Alternative	6-54
6-9	Carbon Monoxide Loadings - No Action Alternative	6-55
6-10	Return Flows of Treated Wastewater to Truckee River (percent of Influent at 40 MGD)	6-76
6-11	Truckee River Water Quality Predicted Changes in Concentrations of Selected Parameters Below Reno JWPCP at 40 MGD and August (Low Flow) Conditions	6-79
6-12	Direct Impacts of Treatment Concepts - Summary and Comparison	6-106
6-13	Direct Impacts of Cross-Town Sewer Alternatives and Sub-Alternatives - Summary and Comparison	6-126
6-14	Impacts of No Project for the Cross-Town Sewer - Summary	6-130

LIST OF FIGURES
(Continued)

Figure No.		Page No.
6-15	Direct Impacts of Lawton-Verdi Alternatives and Sub-Alternatives - Summary and Comparison	6-144
6-16	Impacts of No Project for the Lawton-Verdi Interceptor - Summary	6-148

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
100 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94111

To All Interested Agencies, Public Groups and Concerned Individuals:

The Draft Environmental Impact Statement/Environmental Assessment for the Reno-Sparks Joint Water Pollution Control Plant, Cross-Town Sewer and Lawton-Verdi Interceptor Extension is submitted for your review and comment. This statement has been prepared in compliance with the National Environmental Policy Act of 1969 (P.L. 91-190), and implementing regulations promulgated by the Council on Environmental Quality and the Environmental Protection Agency.

Comments should be sent to this office within forty-five (45) days of the date of this letter. All comments received will be considered in the preparation of the Final Environmental Impact Statement for this action.

In order to receive public comment, the Environmental Protection Agency, Region IX, and the City of Reno, Nevada will hold public hearings on the Draft EIS during February 1977. The times and places for these hearings will be provided at a later date.

All interested parties are invited to express their views at the hearings. Persons wishing to make comments may submit same in writing and/or appear at the hearings. Oral statements will be considered, but, for the accuracy of the record, all important testimony should be submitted in triplicate to:

Environmental Protection Agency
Attention: Hearings Office
Region IX
100 California Street
San Francisco, CA 94111

Enough copies of written material should be provided so that the other interested parties at the hearing may receive a copy. Oral statements should summarize extensive written materials so that there will be time for all interested persons to be heard.

The Draft EIS and supplemental information, including addenda and the facilities plan may be reviewed at:

RENO AREA

Reno City Hall
Public Works Department
S. Center & E. Liberty
Reno, NV

Washoe County Library
Reno Central Branch
301 S. Center
Reno, NV

Washoe County Library
Stead Branch
Mount Charleston & Echo Ave.
Stead, NV

Washoe Council of Governments
350 S. Center
Reno, NV

Sparks City Hall
431 Prater Way
Sparks, NV

Washoe County Library
Sparks Branch
1125 Twelfth Street
Sparks, NV

Washoe County
Public Works Department
1205 Mill Street
Reno, NV

CARSON CITY AREA

State of Nevada
Environmental Protection Services
201 S. Fall Street
Carson City, NV

State Planning Coordinate
Capitol Building
Carson City, NV

Carson City Library
900 Roop Street
Carson City, NV

ENVIRONMENTAL PROTECTION AGENCY

EPA
Region IX Library
100 California Street
San Francisco, CA

Freedom of Information Center
EPA, Room 329
401 "M" Street
Washington, D.C.

Please bring this notice to the attention of all persons who would be interested in this matter.

Sincerely,

Paul De Falco

Paul De Falco, Jr.
Regional Administrator

PREFACE

The Draft Environmental Impact Statement/Environmental Assessment (EIS/EA) for the Reno-Sparks Joint Water Pollution Control Plant, Cross-Town Sewer and Lawton-Verdi Interceptor Extension has been produced through the cooperative effort of the Environmental Protection Agency, Region IX and the City of Reno, Nevada.

As an Environmental Assessment it serves as the written analysis submitted by the City of Reno to EPA which describes the environmental impacts of proposed alternative actions to be undertaken with federal financial assistance under Title II, Wastewater Treatment Works Construction Grants Program of the Federal Water Pollution Control Act (PL 92-500).

As an EIS, this document has been prepared in accordance with the Council on Environmental Quality guidelines and EPA regulations. The preparation of an EIS is required in this instance because the proposed alternative actions are expected to have significant effects on the environment in the Reno-Sparks area and in the Truckee River Basin.

The purpose of the EIS/EA is to:

1) Identify, analyze and assess the environmental benefits and impacts of alternatives to wastewater collection, transport, treatment, reclamation/reuse, and disposal systems for the project area.

2) Publicly present all issues surrounding the project's objectives including the primary and secondary benefits and impacts so that they may be considered and resolved as openly and satisfactorily as possible.

In keeping with the purpose of the EIS/EA, as expressed above, no alternative has yet been selected, proposed for constructio,n or is recommended in the Draft EIS/EA. The most cost-effective, financially feasible, and environmentally acceptable wastewater management alternate with the appropriate system capacity will be selected by EPA and the Nevada Environmental Protection Services after public comments are received and addressed in the final EIS/EA.

Additional supporting technical data has been compiled in a separate document entitled, "Draft Environmental Impact Statement and Addenda." Another separate document entitled "Record of Public Involvement" has also been prepared to record the significant correspondence received during the preparation of the Draft Environmental Impact Statement. Copies of both of these supporting volumes may be reviewed at the public locations noted in the Letter of Transmittal.

PART I

DRAFT ENVIRONMENTAL IMPACT STATEMENT

This section describes the contractual and legal authority for the study and relates the study to water quality planning in the area and objectives set by responsible agencies; the introduction sets the background for the study, provides a brief description of the project alternatives, summarizes the results of the study and concludes with a description of the most viable project alternative selected on the basis of the total environmental effect.

DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE RENO-SPARKS JOINT WATER POLLUTION CONTROL PLANT,
CROSS-TOWN SEWER AND LAWTON-VERDI INTERCEPTOR EXTENSION

Draft (X)
Final ( )

Prepared Jointly By:

U. S. Environmental Protection Agency
Region IX
100 California Street
San Francisco, CA 94111

City of Reno
P.O. Box 1900
Reno, NV 89505

Type of Action: Administrative

INTRODUCTION

Grant Applicants

This Environmental Impact Statement is being prepared under a Step 1 Facility Planning grant to the City of Reno awarded by the Environmental Protection Agency (EPA). After determination of an environmentally acceptable project and resolution of major issues, it will be followed by a Step 2 design grant and by a Step 3 construction grant. Federal funding under Public Law 92-500 provides up to 75 percent of the total cost.

Authority for Study

The National Environmental Policy Act of 1969 (NEPA) (Public Law

91-190) requires all federal agencies to, "...utilize systematic interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment..." Section 102 (2) (c) of that act also requires the agency to prepare an Environmental Impact Statement (EIS) on, "...major federal actions significantly affecting the quality of the human environment..."

One of the major Environmental Protection Agency programs involving actions which are candidates for EIS's is the construction grants program as authorized by Title 2 - "Grants for Construction of Treatment Works", Section 201 (g) (1), of the Federal Water Pollution Control Act Amendments of 1972 (EWPCA) (Public Law 92-500). The Act authorizes the administrator of EPA. "... to make grants to any state, municipality or intermunicipal or interstate agency for the construction of publicly owned treatment works...". The National Environmental Policy Act implemented by executive order 11514 and the Council on Environmental Quality (CEQ) guidelines of August 1, 1973 (38FR20550) provides the basic authority for the Environmental Impact Statement which follows.

EIS Criteria

This EIS has been prepared in accordance with CEQ guidelines dated August 1, 1973 and EPA regulations dated April 15, 1975.

EIS Process

The preparation of an EIS is required by several of the criteria stated in EPA's final EIS regulations. Basically an EIS is required in this case because the project is expected to have significant effect on the human environment, specifically water quantity/water quality and land use. Further, the nature and value of these effects is at issue within the project area. The purpose of this EIS is to publicly present all issues surrounding the project's objectives, including primary and secondary impacts so that they may be resolved as openly and satisfactorily as possible. In keeping with the policy of full disclosure, the EIS has been developed as a part of a decision making process to select the most cost-effective, financially feasible, and environmentally acceptable wastewater management alternative with the appropriate system capacity in accordance with local, state and federal objectives.

BACKGROUND

Description of Study Area

The study area for the EIS is that area designated by the Washoe Council of Governments (WCOG), Areawide Water Quality Management Plan (November 1974) as the 1985-1995 regional service area for the Reno-Sparks Joint Water Pollution Control Plant (JWPCP). (See Figure 1-1.) This area is generally known as the "Truckee Meadows".

The area is located in a semi-arid portion of the Truckee River Basin, east of the Sierra Nevada Mountains and west of the Virginia Range within the State of Nevada. The Truckee River is the major water course traversing the area, extending from its headwaters at Lake Tahoe to Pyramid Lake, some 25 miles north-east of the Reno-Sparks area. The upstream reaches of the river serve as the primary source of municipal water for the Reno-Sparks area.

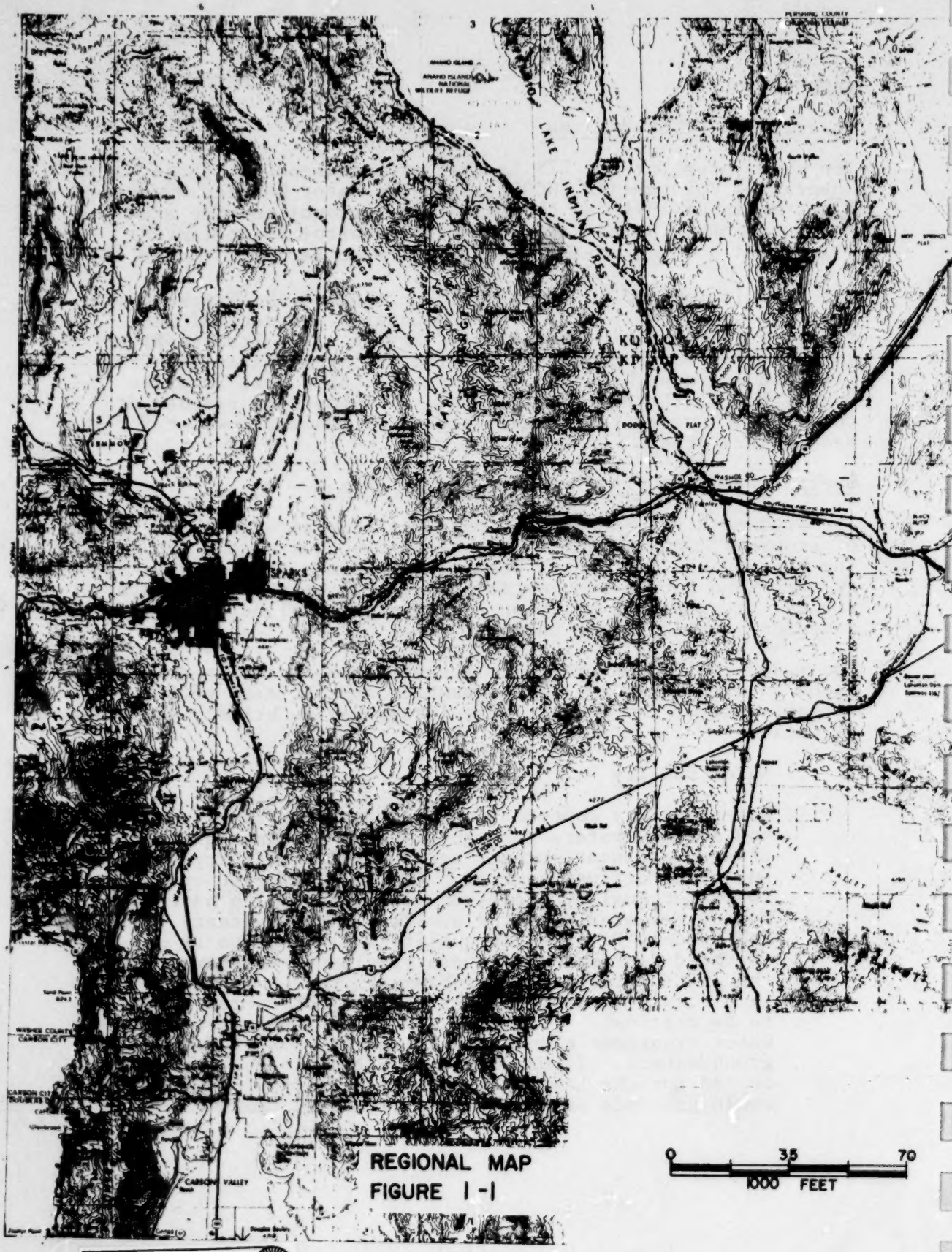
Overall Water Quality Problems in the Area

The Truckee River and Pyramid Lake Basin is affected by a variety of problems, many of which are beyond the control and scope of the Reno-Sparks Wastewater Treatment System. These issues are grouped into four areas, water quality, water quantity, water rights, and ultimate effluent disposition to place the immediate concerns of this EIS in perspective.

The major public concerns with respect to water related issues focus on water quality, water quantity and ultimate effluent disposition for the area. These issues can be briefly summarized as follows:

- Water Quality

  Water quality concerns focus on degradation of ground and surface waters through discharge of inadequately treated effluent, urban, agricultural and dairy drainage and other diffuse sources. The level of, and criteria for water quality standards are issues which have been raised repeatedly by the public. While evidence that the Truckee River water quality will continue to be degraded for some parameters by treated discharge from the JWPCP, groundwater problems in the Lawton-Verdi area as a result of septic tanks use are not currently known to be critical. Problems with local independent wastewater treatment plants add to degradation of surface and groundwaters. If urbanization occurs to the degree forecasted for the Lawton-Verdi area, the resulting density would preclude successful use of septic tanks.



REGIONAL MAP
FIGURE 1-1

Reproduced from best available copy.

Therefore, the problem addressed in the Lawton-Verdi area is one of potential surface water and groundwater degradation.

- Water Quantity

Water quantity issues center on public concern over the increasing demand on the limited water resources in the Truckee Meadows associated with urbanization. Conversion from agriculture open space land use to urban land use will have a negligible beneficial effect on total annual flow quantity downstream from Reno. The reduction in agricultural irrigation water demands will be offset by the increased domestic demands. Municipal water will be diverted in increasing amounts, with the consumptive use (no return flow to river) highest in the summer months when the river flow rate is least.

- Ultimate Effluent Disposition

This issue relates to concerns over whether the ultimate disposition of wastewater effluent should be partially through reclamation, reuse, or continued total discharge to the Truckee River. Discharges to the Truckee River are reused for irrigation and in providing flows to offset evaporation losses in Pyramid Lake.

- Water Rights and Truckee River Litigation

The Truckee River Basin lies in portions of Nevada and California and its lower end is one of the remnants of the pre-historic Lake Lahonton. The river terminates at Pyramid Lake. The Truckee River derives the majority of its flow from the Sierra Nevada including Lake Tahoe with the remainder coming from several tributary streams on which there are regulating reservoirs constructed by the federal government as part of the Washoe project. Municipal water generally is obtained from three sources -- wells, the Truckee River and streams; the Truckee River is the main source of municipal water for the urban Reno-Sparks area of the basin.

Nevada water law is based on the right appropriation which is similar to a property right. Water rights can be transferred from one piece of land to another much like a capital asset. Since Nevada is a desert region and water is a limited resource water rights are of primary importance. The U.S. Government has pending litigation against all the water rights holders on the Truckee River.

These are therefore, focal points around which the total environmental review of wastewater management actions for the area will be assessed.

Planning Basis for Grant Evaluation

The EPA guidelines for municipal wastewater facilities planning states, "The facility planning period should extend 20 years beyond the date when the planned facility is scheduled to begin operation." This has guided the study team in selecting a planning and forecasting horizon of the year 2000 (assuming the plant can be on line by 1980).

Water Quality Planning in the Area

The federal government enacted the Water Quality Act of 1965 (Public Law 89-234) which amended the Federal Water Pollution Control Act of 1956. In accordance with this act, the State of Nevada in 1967 published its Interstate Water Quality Standards and its plan of implementation. These standards appear in the WCOG Area-Wide Quality Management Plan (W-1). In 1972 the federal government enacted the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). In 1973 the Nevada State Environmental Commission adopted water pollution control regulations which established a waste discharge permit program, water quality standards and criteria, a classification system for all reaches of state waters and classified some of the waters according to this system.

The Area-Wide Water Quality Management Plan is the third in a series of planning reports for water and wastewater facilities in Washoe County:

- Rural Communities - Water and Wastewater Plan, prepared for Washoe County by Walters Engineering, 1973.
- "Chapter 6 Public Utilities - Water, Sanitary Sewer, Storm Drainage," prepared for Washoe County by The Regional Planning Commission, 1972.
- Unified HUD, EPA Water Quality Management Plan, Washoe County, prepared for Washoe Council of Governments by Walters Engineering and Metcalf and Eddy, 1975.

Water Quality Objectives

In accordance with Section 303 (e) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) the Washoe Council of Governments (WCOG) has had an area-wide water quality management plan prepared by Walters Engineering and Metcalf and Eddy Engineers, (W-1), which was completed in November of 1975. This report basically identifies the Truckee River water quality standards and existing and projected deficiencies; establishes total maximum daily waste loads and allocations to significant river segments; and recommends effluent standards, needed improvements and priority ranking of necessary projects. Expansion of the JWPCP, extension of the Cross-Town Sewer and the Lawton-Verdi Interceptor are among the first three items in the priority list of ten items.

On January 10, 1975 the EPA issued National Pollutant Discharge Elimination System (NPDES) Permit No. NV0020150 which establishes quality requirements for Reno-Sparks JWPCP effluent to be discharged to the Truckee River. These requirements were established by EPA based on waste load allocations for the Truckee River as recommended in the Area-Wide Water Quality Management Plan and on standards included in Water Pollution Control Regulations issued by the State of Nevada, Environmental Protection Services, October 24, 1973.

Requirements established by the NPDES permit for discharge from the expanded plant include the following:

	Discharge Limitations	
Effluent Characteristic	30-day Avg.	7-day Avg.
BOD (5-day, 20°C)	10 mg/l	15 mg/l
Suspended Solids	20 mg/l	30 mg/l
Total Phosphorus (PO_4)	3.0 mg/l	4.5 mg/l
(P)	1.0 mg/l	1.5 mg/l
Fecal Coliform Bacteria	200/100 ml	400/100 ml
Dissolved Oxygen	Greater than 6.0 mg/l at all times	
ph	Within range 6.5 to 8.5 at all times	

The NPDES Permit for the Reno-Sparks JWPCP called for achieving compliance with the effluent limitations specified for discharges in accordance with the following schedule:

(1) January 1, 1976 Completion of facilities plan.

(2) January 1, 1977 Completion of plans and specifications for facilities necessary to assure compliance with effluent limitations.

(3) On May 15, 1975 the U.S. Environmental Protection Agency transmitted to the City of Reno a memorandum of Understanding pertaining to the determination of the need for an EIS. The EIS procedure has added about two years to the planning process.

From the above, it can be seen that progress toward compliance with the NPDES date is approximately one year behind schedule.

The State Environmental Protection Services advised the City of Reno on March 28, 1975 that ammonia removal by nitrification or other means may be required. The City of Reno was later advised that any proposed improvement program must provide for phosphorus removal to meet current receiving water quality requirements and that the program must be in compliance with the EPA Basin Management Plan to be eligible for construction grant funding.

Related Planning Efforts

The Nevada State legislature created the Truckee River Task Force Committee to coordinate and review Truckee River Planning related to water quality. Interstate water planning for the Truckee River has been slowed by problems associated with interstate and interlocal governmental agreements. In addition to the Task Force Watch Dog Committee, there are a number of agencies with jurisdictional and planning responsibilities for various reaches of the Truckee River. These agencies appear in the Area-Wide Water Quality Management Plan.

The Washoe Council of Governments is initiating an Area-Wide Wastewater Management Study pursuant to Section 208 (PL 92-500). This study will focus on diffused sources of pollution to the Truckee River and management strategies to remove these problems.

A combination of legislative and jurisdictional actions has regulated the water rights of the state in this century from 1903 to the present day.

Most recent actions are the Truckee River Agreement of 1935 and the Orr Ditch Decree of 1944, which incorporates the earlier agreement and refines water rights in the Truckee River Basin. These agreements resulted in the current Floriston Rates which determine the flow in the river. The Orr Ditch Decree is a major subject of the Paiute Indian Tribe suit.

PROJECT BACKGROUND AND DESCRIPTION OF VIABLE ALTERNATIVES

History of the Project

In 1962 the Cities of Reno and Sparks entered into a joint agreement to construct and operate sewage treatment facilties and interceptor lines serving both communities on the basis that such facilities could be built and maintained jointly with substantial savings to taxpayers.

The present treatment plant, located on the south banks of the Truckee River east of Steamboat Creek at Vista, was completed in 1967 with a design capacity of 20 million gallons per day (MGD).

The cost of the plant was originally divided equally between the two communities; providing each with one half the plant's capacity. In 1968 it became obvious that the City of Sparks would not be utilizing its flow appropriation, while Reno appeared to be requiring more than its 50 percent share. The two cities entered into a supplemental agreement which provided for Reno to lease from Sparks the excess capacity rights needed to handle its flows in excess to 10 MGD. In 1972, with the plant at near capacity, the City of Reno recognized the need for additional treatment capacity to provide for future urbanization of the area.

In an agreement of March 1974, later modified, the Cities of Reno and Sparks proposed to share the cost of expansion 85 percent - 15 percent respectively (17 MGD and 3 MGD for a 20 MGD expansion). It was also agreed that the cost of any advanced wastewater treatment and process improvements would be prorated between Reno and Sparks on the basis of their respective share in the total treatment plant capacity.

The wastewater treatment plant expansion program was initiated in 1974 when the city retained the firm of Kennedy Engineers, Inc. to prepare the Facilities Plan Report.

In addition to the plant expansion, the City of Reno is proposing to extend its sewer service area westerly to Verdi by construction of an interceptor sewer line and reinforcement of the existing interceptor sewer system.

The existing interceptor sewers serve both Reno and Sparks and include stations which meter the flows contributed by each city. Within Reno, sewage is collected and conveyed through a system of sewers which discharge into either the North Truckee Meadows

Interceptor, the Mill Street Interceptor, or the South Truckee Meadows Interceptor.

Planning for the Lawton-Verdi Sewer started with preliminary reconnaissance studies in 1973 which resulted in the 1975 Facilities Plan Report prepared by the engineering firm of SEA, Inc.

The Facilities Plan presented alternatives for routing the sewer line between Lawton and Verdi and its connection with the existing portion of the Cross-Town Sewer in Dickinson Road. The Plan also made provisions for a supplemental section of sewer through the downtown area which will permit sewage flows to be diverted through the Cross-Town Sewer to the Mill Street system from the overloaded North Truckee Meadows Interceptor.

The proposed Cross-Town Sewer would also provide capacity to handle the flows collected by the Lawton-Verdi Interceptor Sewer.

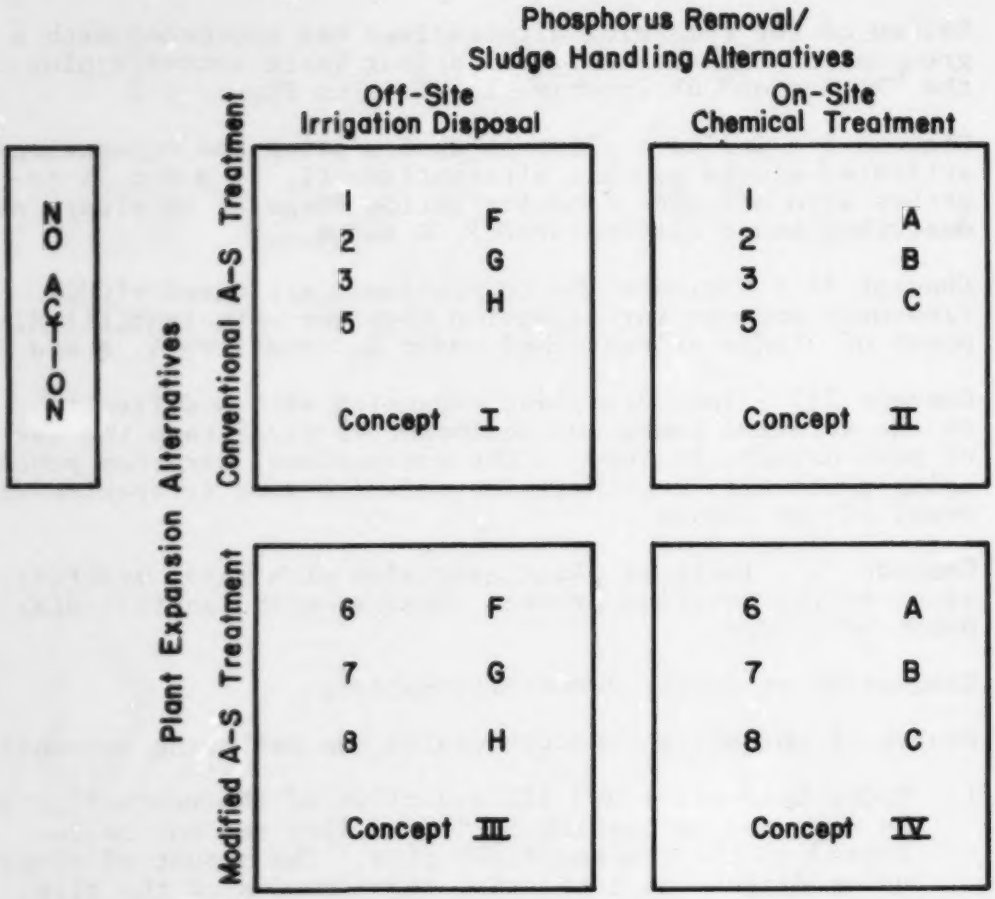
This Environmental Impact Statement is the concluding element in the list of requirements which must be completed and approved by the local, state, and federal governmental agencies to conclude the Step 1 Phase of the Clean Water Grants Program of Public Law 92-500.

Reno-Sparks Joint Water Pollution Control Plant Expansion Alternatives

- Alternatives Screening

  Projected future flows, as well as water quality standards, dictate that an action be undertaken to increase the degree of treatment as well as the design capacity of the Reno-Sparks Joint Water Pollution Control Plant (JWPCP). A series of alternative processes and methods were considered to expand the plant, provide the capability of removing phosphorus from the wastewater and effectively handle the sludge generated in conjunction with the expansion project.

  Certain alternatives were eliminated fairly early from further consideration because of high cost, adverse effect on water quality, and untested technology. One of the sludge treatment alternatives (Alternate D) was modified further as three additional alternatives (F, G, H) providing consideration of land treatment disposal systems for the sludge. The net result of this screening process was the development of the conceptual matrix in Figure 1-2 which displays the viable combination of alternatives presented in the Facilities Plan.



CONCEPTUAL MATRIX TREATMENT/SLUDGE
HANDLING ALTERNATIVES

Source: (K-1)

Figure 1-2

- Viable Alternatives: JWPCP

Review of the remaining alternatives has proceeded with a grouping of the alternatives in four basic concepts plus the "No Action" alternative as shown in Figure 1-2.

Concept I - includes plant expansion using the conventional activated sludge process alternatives (1, 2, 3 and 5) together with off-site land irrigation disposal of sludge as described under Alternatives F, G and H.

Concept II - includes the conventional activated sludge treatment process for expansion together with landfill disposal of sludge as described under Alternatives A, B and C.

Concept III - includes plant expansion with modification to the aeration tanks and equipment to facilitate the use of pure oxygen, instead of the conventional aeration process using plain air, together with off-site land irrigation disposal of the sludge.

Concept IV - includes plant expansion with major modifications to the aeration process together with landfill disposal of sludge.

- Evaluation of Viable JWPCP Alternatives

Review of the above concepts yields the following comments:

1. Under Concepts I and III a portion of the wastewater would be exported to Spanish Springs Valley and not be returned to the Truckee River flow. The amount of diverted water depends on irrigation requirements of the site. Two pipelines would be constructed to convey the sludge and supernatant flows. Ponds would be built to store sludge and phosphorus-rich supernatant in the winter months.

2. Under Concepts II and IV the entire plant effluent would be discharged into the river. Sludge generated at the plant would be disposed of by land disposal at a site at some distance from the plant or by incineration.

3. Concept I requires the least amount of chemicals while Concept IV requires the greatest amount of chemical usage.

4. Concepts I and III have lower labor requirements than the others. These sludge-irrigation-use concepts would need from 5 to 6 less operating persons.

5. Concept I has the lowest energy needs with its air diffusion system for the activated sludge process.

6. Concepts I and III would result in less water and solids being released to the Truckee River system, but will augment the groundwater supply at the irrigation site.

7. Concepts II and IV effluent would contain a residual of calcium and/or aluminum to the Truckee River system.

8. Concepts I and III would not require expensive sludge handling units and will offer an opportunity to return water and nutrients to the land.

9. Concepts I and II have the lowest percent worth costs as shown:

Concept I	$32.8 - $40.8 Million
Concept II	$25.9 - $37.7 Million
Concept III	$34.3 - $76.9 Million
Concept IV	$24.5 - $72.9 Million

10. Concept IV has the lowest capital costs expressed in 1975 dollars, ranging from $11.96 million for Alternatives 6C and 7C, to $13.24 million for Alternate 8A.

11. Sludge incineration under Concept II requires greater amounts of energy and will result in significant atmospheric discharges.

12. If no additional plant facilities are constructed and projected growth is realized the treatment facility will be overloaded by 1978, effluent quality would decrease and compliance with sludge handling and phosphorus removal requirements could not be met.

Cross-Town Sewer and Lawton-Verdi Interceptor Alternatives

- Cross-Town Sewer Alternatives Screening

The Cross-Town Sewer extension planning takes into account and is influenced strongly by the extensive existing network of sewage interception into which it is tributary. The Cross-Town Sewer has been designed for the purpose of

providing relief capacity for the currently overloaded North Truckee Meadows Interceptor. The Cross-Town sewer will also provide the point of connection to the sewer system for the Lawton-Verdi Interceptor.

The clearest mandate for action centers on the Cross-Town Sewer project. Protection of public health, safety and welfare as well as Truckee River water quality from the serious threat of raw sewage overflows from presently overloaded sewers would be accomplished with implementation of this project. The action is compatible with planning goals for the area and is an intergal part of City of Reno Master Sewerage Program. This project will facilitate urbanization in the northwest and west Reno areas and serve as a hook-up point for the Lawton-Verdi Interceptor, facilitating urbanization in that corridor as well. In addition it will allow for additional sewer connections in downtown Reno.

- Viable Alternatives: Cross-Town Sewer

This sewer line involves a total of six routes described in the Facility Plan and labeled A through F for description purposes. The proposed interceptor sewer will connect two existing sections of the Cross-Town Interceptor. The proposed connection can be considered to consist of two sections. The first described as running from the intersection of Mill Street and Kirman Avenue through the downtown area and across the river to the intersection of Jones Street and Riverside Drive, for which there are only three route alternatives.

The A and B options (see Figure 1-3) follow the same route and are herein identified as the AB alignment; C and D, as presented in Figure 1-4, follow the same route and are known as the CD alignment, and the E and F route is identified as the EF alignment. The EF alignment was later discarded from further consideration on the basis of both high initial construction costs as reported in Table 1 of Appendix A of the Facility Plan, and the obvious significant environmental considerations of attempting to install an interceptor sewer along the banks of the Truckee River.

For the second section from Jones Street and Riverside Drive to the westerly limits of the project the sewer interceptor can be installed on either Riverside Drive or Jones Street and this option is labeled as either the R or J Sub-alternative.

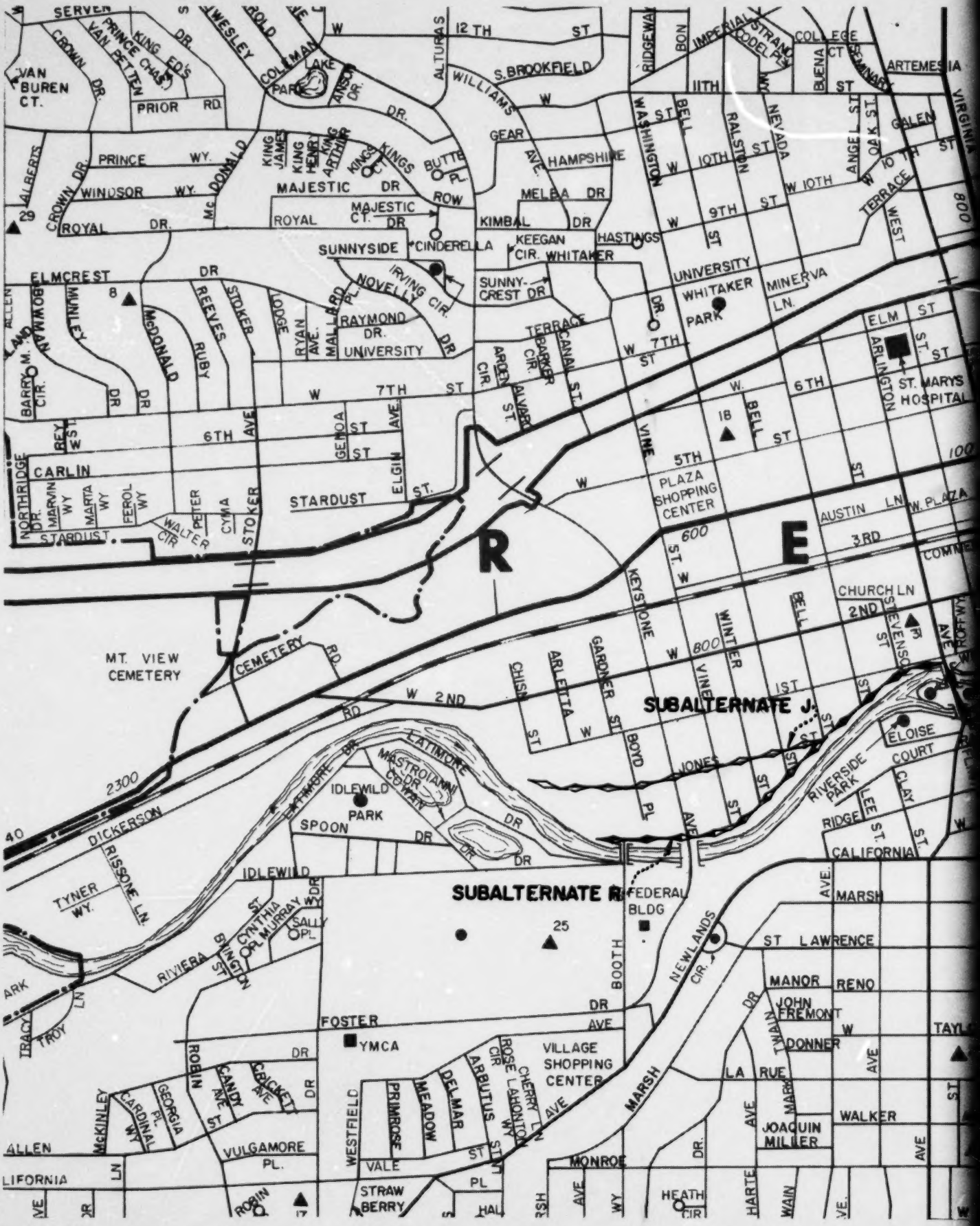
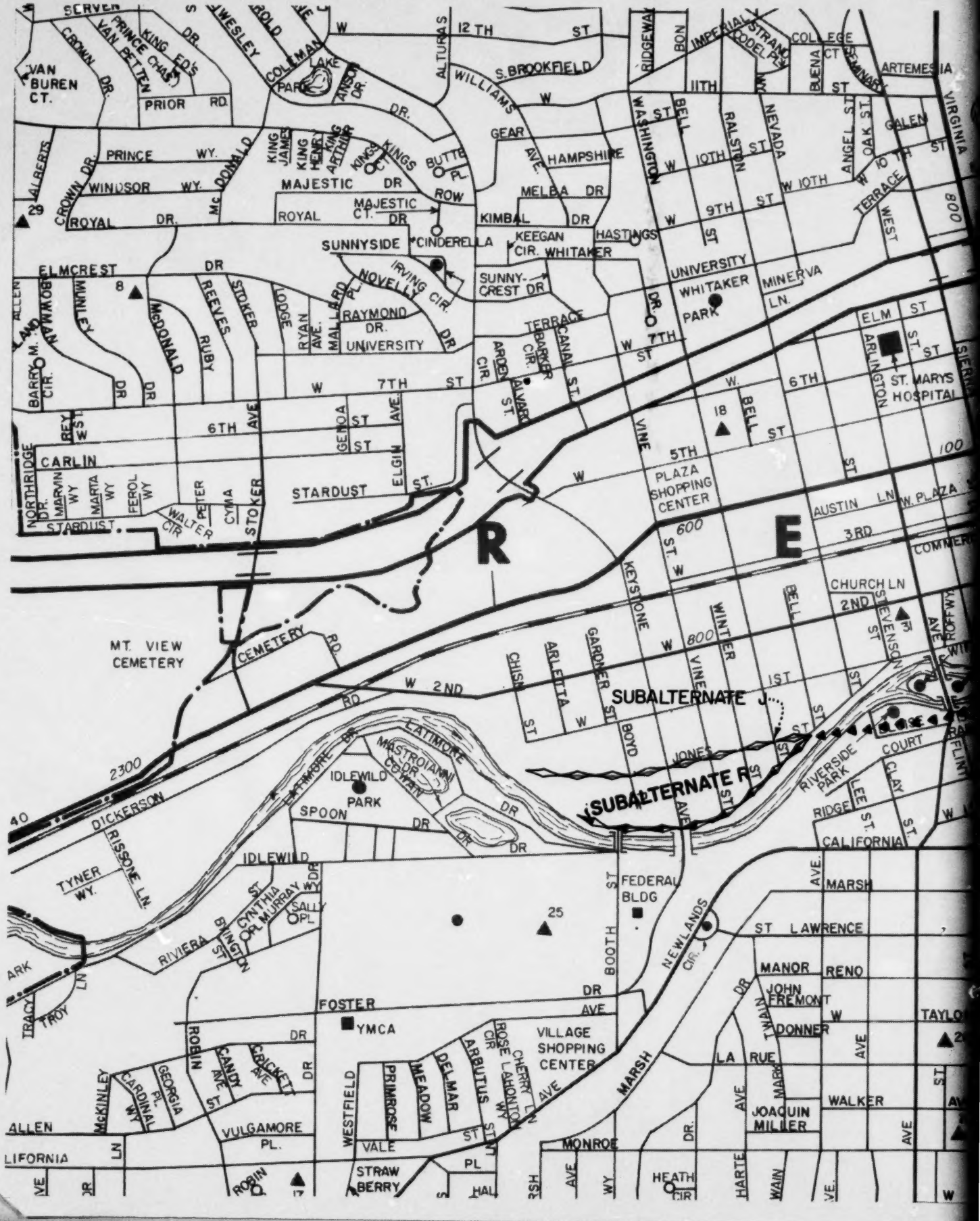
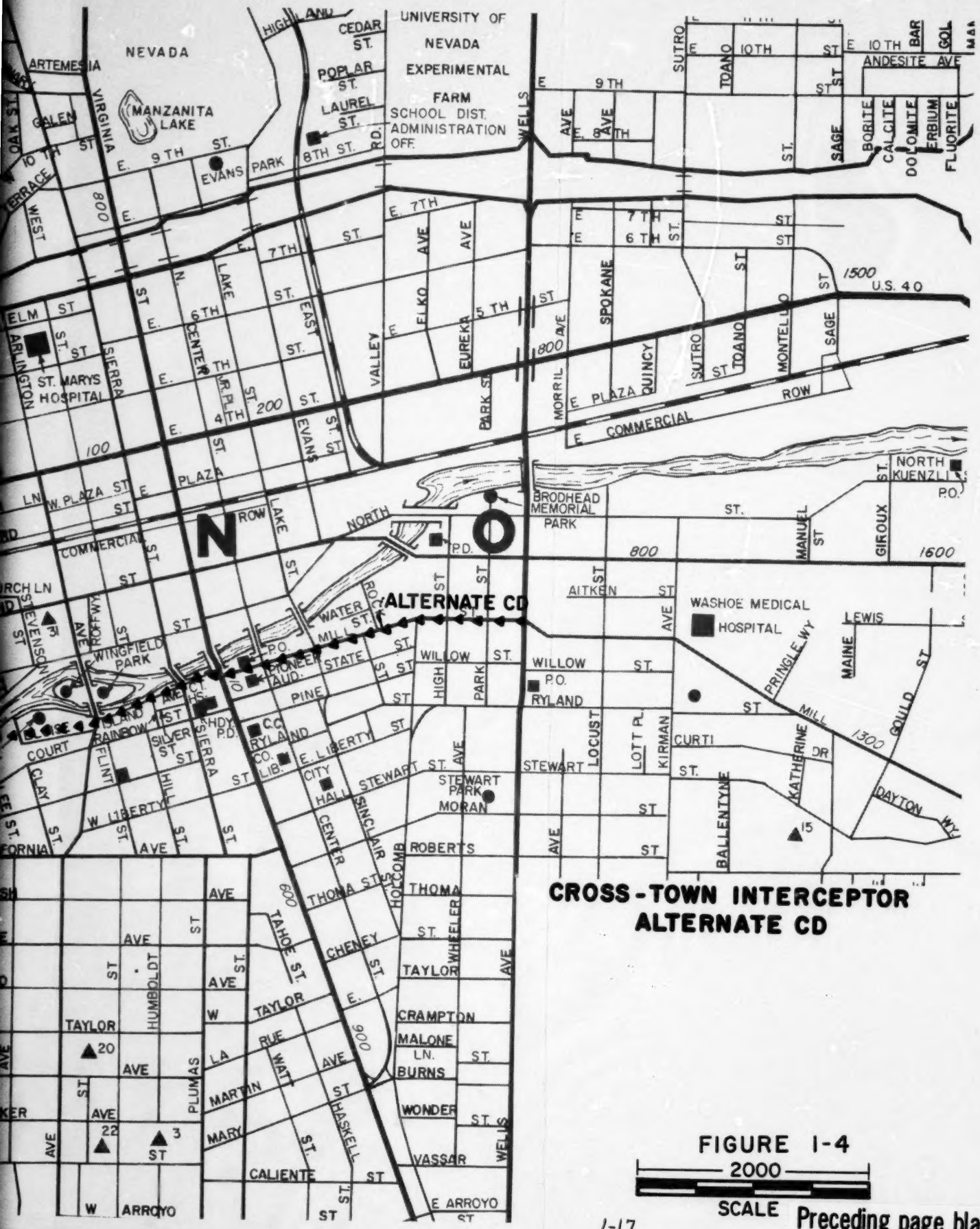

SERVER
VAN BUREN CT.
PRIOR RD.
CROWN DR.
VAN BETTEN
PRINCE CHAS
KING EDS
WESLEY
COLEMAN
LAKE PARK
ANSON DR.
ALTURAS
12TH ST
S. BROOKFIELD
WILLIAMS
RIDGEWAY
IMPERIAL
STRAND
COLLEGE
ARTEMESIA
VIRGINIA
11TH ST
BUENA CT
GALEN
ALBERTS
PRINCE WY.
WINDSOR WY.
ROYAL DR.
McDONALD
KING JAMES
KING HENRY
KING ARTHUR
KINGS CT
KINGS ROW
BUTTE PL.
MAJESTIC DR
MAJESTIC CT.
GEAR AVE.
HAMPSHIRE
MELBA DR
KIMBAL DR
HASTINGS
KEEGAN CIR.
WHITAKER
SUNNYSIDE
CINDERELLA
IRVING CIR.
NOVELLI
SUNNY-CREST DR
ELMCREST DR
ALLEN
BOWMAN
WINNLEY
REEVES
STOKER
LODGE
RYAN AVE.
MALLARD PL
RAYMOND DR.
UNIVERSITY DR
McDONALD
RUBY
BARRY M. CIR.
REY ST
6TH AVE
GENOA ST
ELGIN AVE.
7TH ST
CARLIN
NORTHRIDGE DR.
MARVIN WY
MARTA WY
FEROL WY
PETER
CYMA
STOKER
WALTER CIR
STARDUST
STARDUST ST.
TERRACE
CANAL ST.
BARKER CIR.
ARDEN CIR.
ALVARADO ST.
WASHINGTON
BELL ST
RALSTON ST
NEVADA
ANGEL ST
OAK ST
10TH ST
9TH ST
UNIVERSITY
WHITAKER PARK
MINERVA LN.
TERRACE
WEST
ELM ST
ARLINGTON
ST. MARYS HOSPITAL
6TH
BELL ST
5TH
PLAZA SHOPPING CENTER
VINE
AUSTIN LN
W. PLAZA
3RD
CHURCH LN
2ND
STEVENSON
KEYSTONE
WINTER
GARDNER ST
ARLETTA
CHISM ST
BOYD PL
JONES ST
1ST
ELOISE COURT
RIVERSIDE PARK
LEE ST
CLAY ST
RIDGE ST
CALIFORNIA
MT. VIEW CEMETERY
CEMETERY RD
W 2ND RD
LATIMORE DR
LATIMORE
MASTROIANNI CT
IDLEWILD PARK
SPOON DR
DICKERSON
RISSONE LN
TYNER WY.
IDLEWILD DR
SUBALTERNATE J.
SUBALTERNATE R
FEDERAL BLDG
BOOTH
NEWLANDS CIR.
MARSH
ST LAWRENCE
MANOR
RENO
JOHN FREMONT
DONNER
LA RUE
WALKER
JOAQUIN MILLER
TWAIN
HARTE
WAIN
HEATH CIR.
MONROE
RIVIERA
CYNTHIA
MURRAY WY
SALLY PL
BYINGTON ST
TRACY
TROY LN
FOSTER AVE
YMCA
VILLAGE SHOPPING CENTER
ROBIN
CANDY AVE
CRICKET AVE
GEORGIA
CARDINAL WY
McKINLEY
VULGAMORE PL.
WESTFIELD
PRIMROSE
MEADOW
DELMAR
ARBUTUS
ROSE LAHONTON CIR.
CHERRY LN
VALE
STRAWBERRY PL
ALLEN
LIFORNIA
2300
600
800
1000
29
8
18
25
40

FIGURE 1-3

2000

SCALE


SUBALTERNATE J
SUBALTERNATE R
R
E
MT. VIEW CEMETERY
CEMETERY RD.
IDLEWILD PARK
SPOON DR.
LATIMORE DR.
MASTROIANNI CIR.
COWAN DR.
LATIMORE DR.
DICKERSON RD.
TYNER WY.
RISSONE LN.
IDLEWILD DR.
RIVIERA DR.
CYNTHIA ST.
MURRAY WY.
SALLY PL.
FOSTER AVE.
YMCA
VILLAGE SHOPPING CENTER
FEDERAL BLDG
NEWLANDS CIR.
BOOTH ST.
MARSH AVE.
ST LAWRENCE
MANOR DR.
RENO
JOHN FREMONT
DONNER
LA RUE
WALKER
JOAQUIN MILLER
MONROE
HEATH CIR.
HARTE
WAIN
VULGAMORE PL.
VALE PL.
STRAWBERRY
WESTFIELD
PRIMROSE
MEADOW
DELMAR
ARBUTUS
ROSE LAHONTON CIR.
CHERRY LN
ROBIN
CANDY AVE
CRICKETT AVE
McKINLEY
CARDINAL WY
GEORGIA
ALLEN
CALIFORNIA
RIVERSIDE PARK
RIDGE
LEE
CLAY
COURT
CHURCH LN
2ND
STEVENSON ST
AUSTIN LN
W. PLAZA
3RD
COMMERCE
PLAZA SHOPPING CENTER
5TH
6TH
7TH
10TH
11TH
12TH
9TH
ELM ST
ARLINGTON
ST. MARYS HOSPITAL
WHITAKER PARK
UNIVERSITY
MINERVA LN.
HASTINGS
KEEGAN CIR.
WHITAKER
KIMBAL DR
MELBA DR
HAMPSHIRE
GEAR AVE.
WILLIAMS
S. BROOKFIELD
ALTURAS
COLLEGE
ARTEMESIA
VIRGINIA
GALEN
OAK ST
ANGEL ST
TERRACE
WEST
NEVADA
RALSTON
BELL
WASHINGTON
RIDGEWAY
IMPERIAL
STRANG
COODELPH
BUENA CT
SEMINARY
CINDERELLA
SUNNYSIDE
SUNNY-CREST DR
IRVING CIR.
NOVELLY
RAYMOND DR.
MALLARD PL
RYAN AVE.
LODGE
STOKER
REEVES
RUBY
McDONALD
MINTLEY
BOWMAN
ELMCREST DR
CROWN DR.
ROYAL DR.
WINDSOR WY.
PRINCE WY.
MAJESTIC DR
MAJESTIC CT.
ROYAL
KING JAMES
KING HENRY
KING ARTHUR
KINGS CT.
KINGS
BUTTE PL.
ROW
ALBERTS
PRIOR RD.
VAN BUREN CT.
CROWN
VAN BETTEN
PRINCE CHAS
KING EDS
DR.
WESLEY
COLEMAN
LAKE PARK
ANSON DR.
SERVEN
BARRY M. CIR.
ALLEN LAND
NORTHRIDGE DR.
MARVIN WY
MARTA WY
FEROL WY
CARLIN
REY ST
WALTER CIR
PETER
CYMA
STOKER
STARDUST
ELGIN AVE.
GENOA ST
6TH AVE
7TH ST
ARDEN CIR.
ALVARADO ST.
BARKER CIR.
CANAL ST.
VINE
KEYSTONE
GARDNER ST
ARLETTA
CHISN ST
BOYD
WINTIER
JONES
1ST
2ND
2300
40
25
18
29
8
800
600
100



Preceding page blank

- Evaluation of the Viable Cross-Town Sewer Alternatives

Review of these alternatives as well as a "no project" option yields the following comments:

1. The AB-R Alternative contains the shortest length of pipe at the lowest estimated construction cost of $1,657,000.

2. The J Sub-alternative will create a significant traffic problem at Jones Street and the Keystone Avenue bridge.

3. The CD Alternative with its longer diagonal river crossing will have a significantly greater disturbance of the aquatic flora and fauna.

4. The R Sub-alternative may have some minor scenic and aesthetic impacts on the Reno Scenic Drive in that area.

- Lawton-Verdi Interceptor Alternatives Screening

The initial screening of sewerage alternatives indicates that options which could be considered include:

1. Septic Tank Maintenance Districts.
2. Local Treatment Plants.
3. Interceptor Sewer Project.
4. No Project.

Septic tank use is dependent on local soil conditions and density of urbanization. Low density residential development can be accommodated by septic tanks; however, medium and high density residential development; commercial and industrial uses are not adequately served by septic tanks. The Facilities Plan forecasts substantial medium density residential land use. At this time a land use plan has not been completed by the Regional Planning Commission; therefore the kind and amount of residential, commerical, industrial, open space/recreation, public and other land uses are not known. However, the density of residential development required by the Facility Plan population forecasts is normally accompanied by such ancillary land uses and these have been assumed in the analysis of land use impacts. Preliminary findings by the Regional Planning Commission staff were considered in the Facility Plan preparation and in this EIS. Under the conditions assumed, the use of septic tanks would not be feasible.

Preceding page blank

Community treatment plants and stabilization ponds of questionable efficiency and reliability are another alternative to serve the projected population growth. Wastes from these types of facilities will ultimately find its way into the groundwater table and into the Truckee River above the point of withdrawal for domestic water supply. The increasing number of individual treatment facilities could make effective operation and monitoring very difficult which will have the combined effect of reducing the high water quality standards of the area. Economics of scale and plant operating efficiency, available on a large regional facility, would be absent in local treatment plants.

The no project alternative would force use of either septic tanks or local treatment plants or would prevent urbanization in the Lawton-Verdi corridor. Under the projections in the Facility Plan, the feasible alternative is some form of interceptor sewer to convey sewage to the JWPCP.

- Viable Alternatives: Lawton-Verdi Interceptor

This interceptor sewer involves three alternate routes described in the Facility Plan, a route along the river, a route along the rail line and a combination of the two.

- Evaluation of Viable Lawton-Verdi Interceptor Alternatives

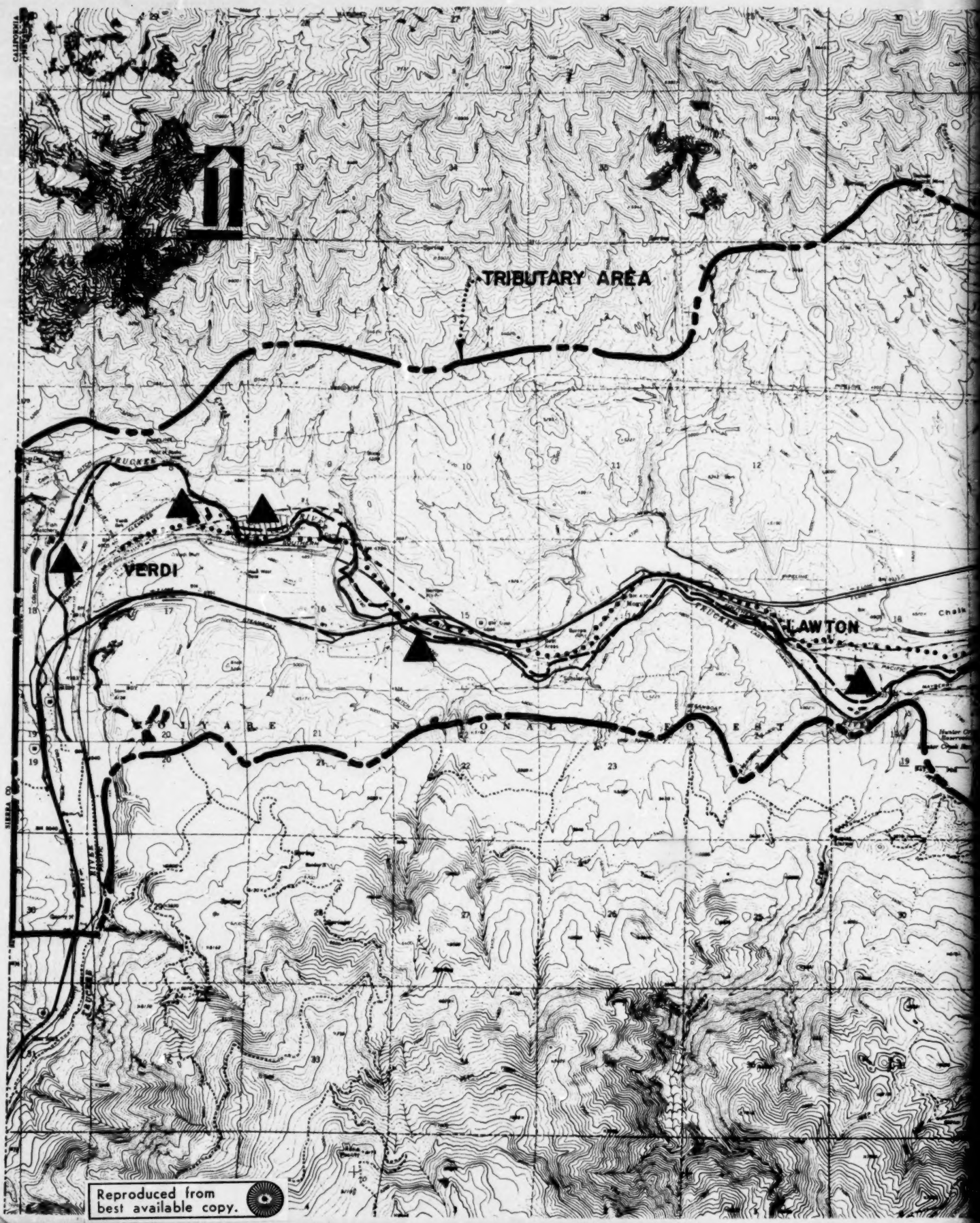
Initial screening for the environmental assessment concluded that the combination alignment be discarded from detailed consideration and review of the other routes yields the following comments:

1. The river route, as presented in Figure 1-5, includes twelve main line crossings while the railroad route only requires four crossings of feeder services which potentially impact the water quality in the Truckee River.

2. The railroad route, as shown in Figure 1-5, requires seven local pumping stations to serve low lying areas.

3. The railroad route will require almost 4000 lineal feet of trestle construction which will affect the natural beauty of the area.

4. The river route is more likely to be located below the water table and subject to inundation during floods with the resulting potential adverse impact on groundwater quality.



Reproduced from best available copy.

LAWTON-VERDI INTERCEPTOR ALTERNATES

LEGEND

——— RIVER ALTERNATE

..... RAILROAD ALTERNATE

▲ PUMP STATION

FIGURE I-5

0 4000 8000 12000

SCALE

5. The railroad route to Verdi has the lowest construction cost of $8,918,000 which is almost $600,000 less than the river route.

6. The sewer line installation to Lawton only is estimated to cost $4,050,000 (along the river route). If the sewer line is installed along the railroad route to Lawton only at this time and no action is taken now to continue the line to Verdi, the environmental impacts could be minimized and a goal of concentrating future growth around an existing urban core where services can be preserved.

7. If no interceptor project is constructed, major adverse impacts would include risk of groundwater contamination, potential risk of surface water contamination with associated effects on aquatic biota and significant changes and restraints to the planned development and urbanization in the Lawton area.

Preceding page blank

SUMMARY ENVIRONMENTAL IMPACT EVALUATION OF VIABLE PROJECT ALTERNATIVES

Methodology

The environmental assessment of the project alternatives is presented in the format specified in the CEQ Guidelines. These guidelines prescribe that the existing environment be described in terms of natural physical, man-made and socio-economic parameters so as to identify environmentally sensitive issues subject to primary and secondary project impacts. The project and its alternatives are described and an initial selection of viable alternatives is made. The viable alternatives are then subjected to an impact analysis in which a forecast is made of the future environment with the project. The alternative future environments are compared with one another and with future environment with no project, as required by CEQ guidelines. Mitigating measures which can be implemented to reduce or eliminate adverse impacts are also presented. The balance of the report details unavoidable, short term, long term and irreversible impacts. Recommendations for specific project selection will be made after formal hearings and receipt of public input concerning the project alternatives.

Environmental Goals and Constraints

The Reno-Sparks Joint Wastewater Treatment Plant planning has the goal of achieving and operates within, a combination of federal, state and local mandatory and/or advisory regulations with respect to a number of parameters. Chief among these are the NPDES discharge requirements, the State of Nevada water quality standards, as they are applied to various reaches of the Truckee River, and federal air quality standards. Other standards such as county, state and federal drinking water standards, nonpoint source water quality and point source air quality standards also apply. In addition, there are a series of laws, policies and regulations, such as federal legislation encouraging floodplain management and protecting rare or endangered plant and animal species which are related ultimately to the shaping of urbanization. The discharge standards involve primary impacts; all the others involve secondary and tertiary impacts of the proposed project.

- Wastewater Treatment and Discharge Requirements

  The Reno-Sparks JWPCP is presently capable of meeting the effluent quality requirements set forth in the existing interim permit. Phosphorus removal will be required by mid 1977.

The state water quality standards applicable to the reach of the Truckee River below the JWPCP at Vista are accounted for in the NPDES discharge standards. In September 1976, the state assumed the permit issuance responsibility, previously handled by EPA.

- Air Quality Requirements

Federal air quality standards, currently including suspended particulates, carbon monoxide, hydrocarbons, oxides of nitrogen, sulfur dioxide and photochemical oxidants, must be achieved by certain mandated dates. The State of Nevada and Washoe County air quality standards for suspended particulates, carbon monoxide and photochemical oxidants are presently being exceeded. Carbon monoxide levels are forecasted to reach standards by the year 1981. However, national standards for particulates and oxidants are estimated to continue to be violated through the year 2000.

The following summarizes the forecasted impacts of the proposed actions (JWPCP, Cross-Town and Lawton-Verdi) under each of the viable alternatives in addition to the no project option for each of the projects. Regional impacts and effects on the lower Truckee-Pyramid Lake are analyzed considering all three projects together. Site environs impacts are considered for each of the three projects separately.

None of the regional level impacts are particularly sensitive to the project design alternatives, but rather to the project versus no project option. Many of the impacts of the site environs and lower Truckee-Pyramid Lake level are also insensitive to project design alternatives. Those impacts which are design-sensitive will be identified as such.

Minimal Regional Secondary Impacts

Impacts on the regional topography, scenic and aesthetic environment, climate, recreation, resources, drainage and flood control facilities, acoustics environment, groundwater hydrology and quality, water use and Truckee River flow quantity have been determined to be minimal as a result of project implementation under any of the viable alternatives.

If the no project alternative is chosen, those minimal effects can be avoided, assuming no further population growth occurs. If population growth continues, with urbanization at a lower density to

accommodate septic tanks and local treatment plants, groundwater quantity/quality will be adversely affected; however the effect on flood facilities and basin hydrology would be somewhat reduced.

Significant Regional Secondary Impacts

- Regional Surface Water Quality

  Implementation of the project under any of the viable alternatives will reduce the need for local treatment facilities and septic tanks. This will have a positive impact on surface waters and near surface water quality in that forecasted residential land use densities will not permit continued safe use of septic tanks as a means of sewage disposal. Local treatment facilities do not operate as efficiently as a large, regional facility. This is particularly significant in the upstream reaches of the Truckee River which serve as the primary source of municipal water for the study area. As agricultural and open space land use are replaced by urban land use, storm runoff which now percolates into the ground will be replaced by urban runoff flows. Pesticides and fertilizers common to agricultural areas will be replaced in storm runoff by urban flows containing petrochemical substances. These non-point source water quality characteristics, and treatment and mitigation thereof, are the subject of a 208 planning study that has just gotten underway.

  If the no project alternative is selected, and there is no significant growth, there will be little change in surface water quality. If population growth continues to occur in the absence of the project, increased reliance on septic tanks and local treatment facilities will increase the potential for adversely affecting the groundwater and, ultimately Truckee River water quality.

- Demographics

  The facility planners have used an adjusted WCOG population forecast as the basis of the design population for the expansion project. The WCOG 1995 Regional Service Plan population forecast of 253,705 was assumed in the EIS to occur in the year 2000; this corresponds to a total equivalent Regional Service Area population of 296,180, including tourists.

  The design population forecast used by the facility planners is forecasted mid-range in a wide band of forecasts made by a number of government, university research and

private agencies. These forecasts are based on economic and demographic trends and assume necessary urban facilities will be available to accommodate the populations involved.

Since population forecasting is not precise, a number of factors, such as water conservation and reduction in per capita wastewater flow, could affect the population represented by a given total wastewater flow. Most of the significant impacts are secondary population-derived. The population used for purposes of impact assessment for the Regional Service Area is 296,200. This will make a conservative worst-case assessment available to decision-makers who must consider the project alternatives and their impacts. If the project is staged, the implementation will be such that the full design population would be accommodated at the time the demand occurs.

- Land Use

Implementation of the project, including the JWPCP expansion, the Cross-Town Sewer extension and the Lawton-Verdi Interceptor under any of the design alternates will facilitate urbanization and population expansion with significant land use impacts. By the year 2000, according to population distribution forecasts in the Facilities Plans, urbanization in Reno-Sparks will have consumed about 10 square miles to accommodate the expected population increase. This is approximately 13 percent of the remaining available stock of developable land in the Reno-Sparks area. In the area extending from the western Reno city limit through Lawton to Verdi, residential development and population increase is estimated to consume an additional 10 to 15 square miles of area by the year 2000 depending on the density and ancillary development assumed. This is as much as 87 percent of the available stock of developable land in the Lawton-Verdi corridor. If this projected intense urbanization of the Lawton-Verdi corridor does not occur and the entire forecasted population locates in the Metropolitan Reno-Sparks Area, it would consume approximately 20 square miles or about 26 percent of the available supply of developable land. Thus, the project will have significant secondary land use impacts, particularly in the Lawton-Verdi corridor. The Regional Planning Commission is up-dating the general plan to provide a current policy to guide and control future land use.

If the no project alternative is chosen for the treatment facility expansion, and population continues to increase, future urbanization will have to rely on septic tanks or local treatment plants. The result will be that development which does occur will be at a lower density than is currently the practice, and a greater amount of land will be used to accommodate the population.

- Urban Systems and Energy Use

Transportation

Urbanization accommodated by the project will have a significant impact on the transportation network, regardless of the design alternative. Such urbanization has been anticipated by transportation planners in the form of a regional transportation plan which is updated continually (Truckee Meadows Urban Transportation Study). The most significant impact will be in the Lawton-Verdi area, particularly if significant urban development occurs in the area between Lawton and Verdi. This level of urbanization had not been anticipated in the Transportation Study. To accommodate the predominantly Reno-oriented travel from the Lawton-Verdi corridor, future planning should provide for extension of future east-west arterials into the Verdi area. Daily average vehicle miles will increase from approximately 2.3 million to approximately 4.7 million by the year 2000 in the study area.

In the absence of any projects - the no project alternative - any urbanization which occurs will probably be at a lower density and total population growth. The net effect may be to create an urban pattern in which there are fewer but longer trip lengths. The possible effect would be to increase overall daily average vehicle miles, although this has not been specifically forecasted as part of the current EIS.

Solid Waste

Increased urbanization will place a greater demand on the solid waste system; however, the current site is estimated to have a life of 200 years and this impact is considered minor.

Other Sewerage Facilities

The impact of the plant expansion, and particularly the Cross-Town Sewer extension, on other parts of the sewage collection and treatment system is significant and beneficial. Sewage flows from areas tributary to the North Truckee Meadows Interceptor would be diverted to the extending Mill Street (Cross-Town) Interceptor. The North Truckee Meadows Interceptor, which is currently overloaded at peak periods, would be relieved. Regional treatment service would be provided by the Lawton-Verdi Interceptor eventually to Verdi; local treatment plants at Lawton and in the Verdi area would be retired at that time.

If the no project alternative is selected, a total of nine local treatment plants would continue in operation. In the absence of the Cross-Town Sewer, the North Truckee Meadows Interceptor will continue to be subject to overload, with attendant constraints on urbanization in the northwest Reno area, as well as in downtown Reno.

Public Services

Secondary facilitated urbanization will have a significant impact on public services such as public safety, emergency services, general government and education. Although the aggregate impact is significant, the development will occur over a twenty-five year time span and the agencies involved can anticipate the increased service demands in their advanced planning efforts. The economic burden for development of these services will be shared by existing as well as future residents.

Water Supply

Domestic water use is currently on the order of 356 gallons per person per day. This compares with uses in other equivalent cities or between 150 and 200 gallons per person per day (90 to 110 percent greater). This is believed to be related to the use of a flat-rate charge. Currently 17,000 acre-feet, and up to 37,000 acre-feet by the year 2000, of the water used in the service area does not find its way back to the Truckee River. Some of this loss may be reduced by improved water use practices resulting in more favorable return flows to the river.

The Sierra Pacific Power Company (SPPC) which has responsibility for domestic water service in most of the Regional Sewer Service Area, has made its own forecast of water demand in its service area. The SPPC has taken into account available surface water rights and other factors, and the estimate is that up to 330,000 persons within the SPPC water service area could be accommodated utilizing existing water rights under current per capita use rates. As mentioned previously, Truckee River water rights are currently the subject of pending litigation.

Energy Demand

Urbanization will place greater demands on the energy supply system. The local power company (SPPC) has forecasted that by the year 1985 the demand for electricity and gas will more then double. Since electricity energy demands for Nevada are met chiefly by fossil fuels, this increase represents a significant adverse impact. SPPC planning includes provision for this expected demand.

- Economics and Employment

Forecast of employment distribution continues the trend evident over the past thirty-five years - reduced influence of agriculture and mining and a continued increase in the trade, transportation, service and government sectors. Total employment is forecasted to increase from the current 78,000 to approximately 115,000. Total earnings in Washoe County is expected to increase from half a billion dollars in 1970 to approximately two billion dollars by the year 2000.

If the no project alternative is selected, population growth and urbanization may slow to a fraction of that forecasted unless heavy use is made of septic tanks and the local treatment plant. If there is no population increase, growth is unlikely in the economic sector and a decline in economic activity in Washoe County is a distinct possibility.

- Flora and Fauna

Increased urbanization will place greater pressure on the plant communities and associated wildlife in the regional study area. The impact on flora and fauna in the portions of the study area available for development will be relatively minor

because of most of this land is already subject to some urban pressures and agricultural activity and the kind of flora and fauna displaced is not normally rare or endangered. The subtle impact of urbanization on the more remote regions of the county which may affect more significant species of flora and fauna results from increased numbers of hikers, recreation area users, off-road vehicle users and the like. This is a long term cumulative adverse impact.

- Air Quality

Projected population growth and urbanization within the service area accommodated by the proposed expansion of the regional wastewater treatment facilities will be accompanied by continued violations of the NAAQS for photochemical oxidants, and particulate matter through 2000 and future violation of the NAAQS for nitrogen dioxide by the year 2000.

Suspended Particulates

Urban areas in Reno and Sparks have experienced high levels of particulates in 1975 which represents violations of National Ambient Air Quality Standards (NAAQS). The region has been designated an Air Quality Maintenance Area (AQMA) for particulates and EPA has initiated studies to determine the causes and provide mitigative strategies. The sources of emissions for particulates are from both natural events (wind, etc.) and man's activities.

Projections show that travel along unpaved roads will continue to be the largest single man-made contribution to particulate emissions. In general, gross annual particulate emissions will increase slightly in the future to the year 2000. Without mitigative measures, violations will continue.

Photochemical Oxidants

Oxidant concentrations are dependent on atmospheric chemical transformations including hydrocarbons, oxides of nitrogen, and oxygen in the presence of sunlight. Emissions of hydrocarbons in the Reno-Sparks area are produced primarily by gasoline-burning automobiles and secondarily by gasoline storage and handling facilities and open burning.

Projections indicate hydrocarbon emissions from all sources will be reduced by almost 50 percent by 1990.

Although vehicular traffic will be increased by population growth, the effects of increased travel will be offset by stringent auto emission control devices. Emissions from open burning are projected to increase, whereas emissions from gasoline storage and handling facilities will remain constant. Despite the projected overall reduction in hydrocarbon emissions, violations of the oxidant standards up to twice the allowable maximum are projected through 1995 in the absence of mitigative measures.

Nitrogen Oxides

Emissions of nitrogen oxides, primarily from diesel and gasoline powered vehicles, are expected to increase as much as 50 percent by the year 2000 over 1973 levels primarily due to increase in transportation-related sources. Violations of the federal standard for nitrogen dioxide may be expected by the year 2000 without mitigative measures.

Carbon Monoxide

Attainment of NAAQS for carbon monoxide is projected by 1981 for the Truckee Meadows area. It appears that the effects of increased population will be compensated for by increased use of late model cars with efficient pollution control devices so that maintenance of standards will continue after 1981 through the year 2000.

If the existing population level is maintained under a no project alternative, the suspended particulate level should remain relatively stable in the absence of mitigation. Carbon monoxide concentrations should be approximately 50 percent and nitrogen oxides, about 60 percent, less than the levels associated with the population forecasts for the year 2000.

Site Environs Impacts of the Treatment Plant Expansion

- Topography

Expansion of the plant under two of the four alternative concepts will have little topographic impact. Two of the concepts (I and III) involve piping sludge and phosphorus-rich supernatant to Spanish Springs Valley for use in an

irrigation project and involve creating holding ponds and minor surface earthwork.

- Scenic and Aesthetic Characteristics

Expansion of the treatment plant will maintain the land use and visual impact similar to those which currently exist. The major aesthetic impact would occur in Spanish Springs Valley where, in two of the alternatives (Concepts I and III), an area of about 1550 acres will be converted from range land to irrigated cropland. This land use, however, is compatible with the surrounding uses and is not considered a serious detrimental impact.

- Archaeology

The treatment plant itself is located on a pad cut into a hill; expansion of the plant under any of the four alternative concepts would not involve risk to any archaeologic resources. However, the Spanish Springs irrigation site under Concepts I and III does involve potential risk to some archaeologic resources. The irrigation site is proposed in or near Section 36, T21N, R203, which contains 37 archaeologic sites, some of which are significant. A total of 30 secondary sites were discover d along the proposed pipeline route. The impact on these resources can be avoided if the pipe alignment is kept to the easterly side of Spanish Springs Road. The impact of irrigation activities on the archaeologic finds should be assessed further by an archaeologist. It may be that surface disturbance associated with the agricultural activity would not have any significant effects.

- Soils, Geology and Seismicity

Construction of the plant and collected systems will have no major impacts on these resources. A major impact would occur if a seismic event were to cause damage to the plant itself or to one of the interceptor sewer pipelines or transmission lines (Concepts I and III). In such cases, repairs would be made and the problem mitigated as part of the standard operating maintenance procedures. There is the potential for erosion, particularly in the river bank area, during construction.

- Climate and Air Quality

During construction there will be an increase in suspended particulates and other emissions from construction equipment. These are considered to be minor impacts. Concepts II and IV could involve incineration of dewatered sludge, with adding an estimated 72 lb/day to 5,300 lb/day to the current level of suspended particulates to the AQMA, and this potential impact may be significant.

- Acoustics

During construction there will be an increase in noise level from about 79 dBA to about 105 dBA 50 feet from the noise source. This is not considered a serious impact due to its temporary nature.

- Urban Systems and Energy Use

During construction there will be some minor increase in construction-related traffic activity but no interruption in traffic flow. At full operation, Concept II has the potential for requiring the greatest energy of any of the four alternates. Concept I has the lowest range of energy requirements, while Concepts III and IV are about equal in energy demand. However, in general the increased primary energy requirements of the expanded treatment plant are a minor part of the future energy demands of the regional study area. Concepts II and IV have the greatest demand for chemical use as a result of treatment processes employed in them.

- Economics and Employment

Capital and Operating Costs

The capital costs of implementing the JWPCP expansion range from $12.0 to $29.7 million (1975 dollars), depending on the specific alternate. The annual operating and maintenance (O&M) costs range from $0.8 to $5.6 million. The comparative present worth ranges from $24.5 to $76.9 million.

Generally, Concepts I and III, involving transport and irrigation of sludge, have lower annual costs but have higher capital costs because they involve construction of over 10 miles

of tandem pipeline and ponds and dikes in Spanish Springs Valley and purchase of an irrigation area, pumps and sprinkler systems which Concepts II and IV do not have. Concept I has the lowest O&M range of the concepts because it involves the smallest quantity of chemicals and energy input and has a comparatively low labor requirement.

Local funding for the Reno share of the facility expansion is expected to be derived from issuance of general obligation bonds for a 20 year term.

Debt servicing will require additional revenues of approximately half a million dollars annually beginning one year after the bonds are issued. The probable source of these funds is an increase in either or both the sewer service charge or the sewer connection fee.

Local funding for Sparks will also be derived either from accumulated capital reserves or from the issuance of 20 year bonds which will be repaid from sewer service charges and sewer connection fees. Increases in O&M costs are estimated to be funded by increase in total sewer services fee revenues derived from population increases. Debt servicing, amounting to approximately one hundred thirty thousand dollars annually, beginning one year after the bonds are issued, will be funded from sewer service charges and sewer connection fees, either or both of which may have to be increased.

Employment

The estimated total employment requirement is 26 to 36 people including 23 current employees, for 40 MGD treatment. Generally, Concepts I and III (sludge transport and irrigation) involve fewer people than Concepts II and IV which require more labor to accomplish disposal of sludge.

Man years of construction employment is estimated between 216 and 535, varying directly with the capital costs.

The no project alternative involves no new capital costs. Currently the plant has operating and maintenance costs of $0.6 million annually. Present worth of the plant is estimated at $6.7 million. This alternative involves no bond financing or impact on sewer service charge or connection fees. It should be noted that annual costs may

increase in the future from inflationary pressures, necessitating increases in service charges and fees, unrelated to expansion. Even if the no project alternative is selected, phosphorus removal will be mandated in the near future to comply with the NPDES permit. Therefore to view the no project alternative in true perspective, the capital and O&M costs for phosphorus removal are as follows: capital costs = $3.3 million; O&M = $0.2 million (or a total of 0.8 million when added to the current O&M).

Lower Truckee River, Pyramid Lake Basin and Spanish Springs Impacts

- Surface Water Hydrology

The potential hydrologic impacts may be divided into two categories. The first category involves the Truckee River total water volume budget which primarily affects water levels in Pyramid Lake. In this regard the impacts of consumptive use (37,000 acre-ft/yr) of water associated with development of Reno-Sparks to the year 2000 is minor when compared to the total flow into Truckee Meadows of 547,000 acre-ft/yr, or to the Derby Dam diversion (250,000 acre-ft/yr) to meet demands in the Carson River Valley. Total consumption will decrease by 6000 acre-ft/yr, due to presently irrigated agricultural lands being urbanized.

The second category involves the actual river level and/or instantaneous flow rate. Both agricultural and domestic consumptive uses of water reach a maximum in the summer months which coincides with natural low-flow periods. Conversion of existing agricultural water rights to domestic use will change the return water to the river from non-point agricultural flows to discharges of treated wastewater and urban runoff as a trade-off.

- Surface Water Quality

Expansion of the treatment plant under any of the four alternate concepts results in a significant reduction in phosphate loading but an increase in the mass discharge of other parameters, including BOD, TDS, and nitrate.

All four concepts however will occasionally involve violations of phosphate effluent standards, and increases in ammonia and chlorine loadings, in particular, will approach levels identified as toxic in certain fish species. It is recommended that dechlorination (or alternative method) be

part of the wastewater treatment process. It is probable that baseline and monitoring studies will show that ammonia concentrations in the Truckee River are and will continue to be at levels toxic to aquatic organisms; therefore, ammonia removal will probably be necessary in the future as part of the treatment process.

Installation of the proposed diffuser system to discharge effluent into the Truckee River is recommended not to exceed 25 percent of the cross-sectional width of the river at the point of discharge in order not to create a chemical barrier to migrating fish species. As an alternate, flows could continue to be discharged into Steamboat Creek.

The impact of selecting the no project alternative depends upon the population to be accommodated. If phosphate removal is initiated without population growth, there will be about a 40 percent reduction in phosphates and the other parameters will remain at existing levels. If population increase does occur under the no project concept with phosphate removal only, then the other parameters will be adversely affected.

- Flora and Fauna

The increased loading of chlorine and ammonia will probably affect such species as the threatened Lahontan cutthroat trout.

There will be a minor short term impact on the Truckee River caused by construction of the transmission lines to the irrigation disposal site across the river under Concepts I and III. Increased sedimentation loads and suspended particulates can be harmful, particularly during the period when trout eggs could be destroyed by smothering. This impact can be mitigated by closely controlling construction scheduling to avoid this period of time.

Heavy irrigation and leaching of supernatant in Concepts I and III may change the groundwater table close to the irrigation site. This may have an effect on plant communities in the vicinity and could result in changing the natural successional trends of these plants. In addition, the recharged aquifers will supply phreatophytes with additional groundwater. A change in groundwater quality near the Spanish Springs site also has the potential for altering the natural vegetation in the vicinity if nutrients or heavy metals regimes change significantly.

The impact of the no project alternative will vary in proportion to the population which occurs. If phosphate removal, only, is implemented and no growth occurs, phosphate levels will be reduced and other parameter levels will remain approximately at current levels. If significant population growth does occur and the hydraulic capacity is not improved, serious consequences to downstream aquatic fauna will occur. Significant increases in BOD would result in distinct DO sags downstream to Derby Dam. Phosphate levels would increase significantly and contribute to gradually increasing algal activity downstream, which could produce extreme consumptive demands on the DO tension. This, in combination with higher ammonia levels, could combine to produce fish kills. Water quality trends would threaten the existence of the lower Truckee and Pyramid Lake fishery and further reduce aquatic faunal diversity. In addition, suspended soils would increase significantly above present levels causing potential suffocation of benthic communities and suffocation of fish eggs and spawning beds downstream of the plant outfall.

- Recreation

The impact of the project on downstream recreation is proportional to the effluent quality and the impact on sports fishery and water quality in terms of contact and boating sports. If the project is implemented these conditions will be much improved over the no project alternative.

- Groundwater Hydrology and Quality

The major impacts of the treatment plant on groundwater hydrology are associated with export of sludge, phosphorus-rich supernatant or effluent as supplemental irrigation waters to Spanish Springs Valley proposed in Concepts I and III. The major impact is associated with the fact that the quantity of nutrients proposed in the Facilities Plan to be transported to the irrigation site exceeds the estimated capacity of crops to utilize the nutrients.

The principal concern is the nitrate loading which would occur as a result of irrigation in the Spanish Springs Valley. Groundwater which comes into contact with the percolated flow would contain high levels of nitrogen and would probably be rendered unfit for human consumption. In addition, concentrations of certain metals added to the soils could be relatively high.

Cross-Town Sewer Extension Corridor Impacts

- Topography

  The Cross-Town Sewer under either alternate alignment will be constructed primarily in existing streets and will have no long term topographic impacts.

- Scenic and Aesthetic Characteristics

  Scenic and aesthetic impacts are limited to the short term impacts of construction and are similar under either alternate.

  There will be minor inconveniences to residents and commercial establishments and some minor traffic disruptions from the presence of equipment and building materials during construction.

- Recreation

  The project will cause some disruption to downtown Reno with some effect on the tourist recreation industry in either alternate alignment. This disruption will be minor and short term, caused by minor traffic flow disruption and the sight of equipment and building material. One of the routes (AB-R) passes through Wingfield Park, an island in the Truckee River. The impacts on this park would be limited to short term construction activity such as noise, dust and trenching. This route will also parallel a linear park extending from Arlington Avenue to Washington Street on the north side of the Truckee River on Riverside Drive. Although the line would not necessarily pass through the park it would be impacted by adjacent construction activity.

- Archaeology

  It does not appear that the project poses a threat to archaeologic resources under either alignment.

- Soils, Geology and Seismicity

  The project has no effect on these factors under either alignment. The major impact would occur if a seismic event were to cause damage to the line. In such a case, repairs would be made and the problem mitigated as part of the

standard operating procedure.

- Hydrology and Water Quality

The major water quality impact of the Cross-Town Sewer will occur during construction in the segment which crosses the Truckee River near Arlington Avenue, causing the potential for short term siltation and suspended particulates. Alternate AB will create less disturbance to the river bottom than Alternate CD as a result of its alignment. This short term impact can be mitigated by strict construction scheduling to avoid the trout spawning season. The long term water quality impacts of the Cross-Town Sewer are beneficial in that it will eliminate the possibility of surface discharge from overloaded sewer mains from the North Truckee Meadows Interceptor, which would flow to the groundwater and the Truckee River.

The no project alternative has secondary groundwater quality implications particularly in the upstream Lawton-Verdi area where the potential for leaching of material from septic tanks poses the threat of contaminating the Truckee River which supplies most of the water for the Truckee Meadows area.

Thus, the Cross-Town Sewer forms an important link in the overall Sewer Master Plan for the Truckee Meadows area.

- Flora and Fauna

Impacts to flora and fauna are minor. However, because the line crosses the Truckee River near Arlington Avenue it will cause a temporary disturbance and potential for increasing sedimentation and turbidity during construction. Alternate AB will create less temporary impact than Alternate CD.

- Climate and Air Quality

There is no long term impact of the project on these factors. However, during construction the equipment will emit a small quantity of pollutants and cause some increase in suspended particulates with the trenching and other construction activities.

- Acoustics

There is no long term impact on acoustics associated with the project. During construction, there will be a temporary increase in noise in the vicinity of the construction activity.

- Land Use

No homes, businesses or land designated for residential use will be affected over the long term by the Cross-Town Sewer under either alignment.

The Cross-Town Sewer will relieve the presently overloaded North Truckee Meadows Interceptor, which provides service to downtown Reno and to southwest, northwest and west Reno. Although northwest and west Reno are within the water service area of the SPPC, the existing deficient sewage system is effectively preventing urban growth. The project would relieve this condition and facilitate growth in these areas.

If the no project alternative is selected for the Cross-Town Sewer, the negative impacts, most of which are temporary in nature, would be avoided. However, some serious long term impacts would be created. The primary impact of the no project alternative is that the currently overloaded North Truckee Meadows Interceptor would not be relieved. This has consequences for development in the northwest and west Reno area and by reason of not diverting flows also would restrict furth development of the downtown area. The no project alternative would result in growth moratoria in these areas and development would probably be shifted to the eastern and southern parts of the city.

The no project alternative has additional consequences for development in the Lawton area west to Verdi because the Cross-Town Sewer would be the hook-up point for the Lawton-Verdi Interceptor.

- Urban Systems

Construction of the Cross-Town Sewer will be somewhat complicated by in-place facilities, such as other sanitary sewers, storm drains, water, gas and telephone in either alignment. However normal construction practice should avoid disrupting these facilities.

Either alignment will have an impact on traffic during construction. Trenching activity in the street will require a minimum of 20 foot width for stockpiling of dirt, equipment and so on. The major impacts for both alignments will be on Mill Street and one block of Virginia Street both of which have heavy traffic volume. Traffic will have to be rerouted on a temporary basis around the construction area.

- Economics and Employment

The cost of the Cross-Town Sewer is estimated to range between $1.66 and $1.97 million. The annual costs are estimated to be between $161,000 and $190,000. Construction employment is estimated to require between 30 and 35 man years of effort. The differences between the alternate alignments is negligible.

As with the wastewater treatment plant expansion, the local share cost of the project (25 percent) would be funded by the issuance of a general obligation bond with a 20 year maturity, the servicing of which will probably require an increase in sewer service and connection fees.

Lawton-Verdi Interceptor Corridor Impacts

- Topography

Topograhic impacts for both the railroad and river routes are minor and limited to construction access roadways, very minor permanent micro alteration in the river channel and possibly the employment of rip-rap and other erosion prevention measures.

- Scenic and Aesthetic Characteristics

The railroad route involves trestle placement, sewage lift stations, pipe hangers, cutting of benches and employment of rip-rap and other erosion prevention measures. However, much of this activity occurs in the current railroad corridor where a similar man-made facility already has set a visual pattern. The river route requires possibly up to 150 raised manholes in the vicinity of the river and involves a great many more river crossings, causing temporary impact during construction. Therefore this route probably has the greatest adverse aesthetic impact.

- Archaeological Resources

  The railroad alignment does not contain any known archaeological resources. However, the river alignment passes through three major sites which may be disturbed. Detailed archaeological reconnaissance at the time a final alignment is selected should be conducted to determine precise impact and available mitigative measures.

- Hydrology and Water Quality

  The railroad alignment has little effect on water quality other than at a limited number of secondary stream crossings. The river alignment involves numerous primary river crossings and will cause significant temporary siltation as a result.

- Flora and Fauna

  Increased sediment load in the river would result in downstream turbidity and siltation from the river crossings which would blanket benthic communities in the stream. This impact is much more severe under the river alignment than the railroad alternate. If construction occurs during the spawning runs of the Lahontan cutthroat trout or during the early life history of the fry, the increased turbidity and sedimentation could adversely affect this threatened species.

- Air Quality

  The project will involve only minor short term air quality impacts associated with emissions and suspended particulates, created by construction vehicles and activity.

- Acoustics

  There will be a temporary increase in the noise level in the area of construction activity. However, these noise impacts are short term.

- Urban Systems

  The project does not pose a significant impact to any urban system. There will be short term disruption to traffic and the potential for interruption in other urban

facilities, such as gas, electricity, water, and the like. Any such interruption would be very short in duration.

- Land Use

Implementation of the railroad route alternative will have little direct land use impact. The river route would probably require permanent access right of ways.

- Economics and Employment

The river route, Alternate 1, is estimated to involve capital costs of $9.5 million at 1975 prices. The total annual cost, including debt servicing and present worth of operation and maintenance is estimated to be $926,000 on a 20 year amortization basis and $742,000 on 40 year amortization (S-1). This alternate is more expensive to build than the railroad route, primarily because it requires 11,600 linear feet more pipe (caused by river meander); involves twelve primary river crossings, all requiring water-tight pipes and manholes; requires construction of heavy equipment access roads; and involves extensive revegetation and relandscaping in the vicinity of river crossings and access roads. Construction employment is estimated at 171 man years.

The river route involves somewhat lower yearly costs on a 40 year basis than the railroad route, primarily because there are no lift stations to service some low lying tributary areas requiring fuel and maintenance. This alternative will involve impacts on sewer service charges and connection fees amounting to about one half of one percent less than the railroad alternate, a very slight difference.

As with the Cross-Town Sewer, funding for the Lawton-Verdi Interceptor is expected to be derived from federal sources, according to the provisions of PL 92-500, amounting to 75 percent of the total capital costs. Local sources will provide the remainder in the manner previously discussed in relation to the wastewater treatment plant expansion.

The railroad route, Alternate 2, is estimated to cost $8.9 million. Total annual costs, including debt servicing and present worth of operation and maintenance, is estimated to be $921,750 on a 20 year amortization basis and $964,000 for a 40 year amortization. The railroad route will involve some difficult construction techniques, including railroad jacking, tunneling, 3,900 feet of tressels, pipe

hangers, extensive trench shoring and dewatering, and construction of lift stations. Construction employment is estimated at 160 man years.

Funding sources for this alternative are identical to those for the river route. Local revenue sources are also the same. The railroad alignment, because it requires lift stations, has a higher annual cost, amounting to about 2 percent more per year than the river alternate and will correspondingly have a very slightly greater effect on sewer service charges and fees (25 percent of 2 percent or about one half of 1 percent).

DISCUSSION AND EVALUATION OF ALTERNATIVE DESIGN CAPACITIES

The development of the design population for the JWPCP has been previously discussed and is accepted as a given factor in the formulation of alternative design capacities. The design capacity of the JWPCP should reflect the existing flows currently treated (21 MGD), dwellings within service area currently utilizing small local treatment plants and septic tanks (3 MGD) and future development. Alternative design capacities must not only accommodate known flow conditions but also must recognize the engineering constraints incorporated into the design of the existing facilities. That is, capacity expansion alternatives are limited to 30, 33.3 and 40 MGD. Thus, the capacity needed to serve the design population may be constructed all at once or in stages. The following alternative design capacities with the year of expected completion, are set forth for public review and discussion.

Alternative 3H:	40 MGD (1980)
Alternative 3H1:	30 MGD (1980), 40 MGD (1987)
Alternative 3H2:	33.3 MGD (1980), 40 MGD (1991)

If the present per capita contribution of 135 gallons per person per day remains unchanged, flows are projected to reach 30 MGD in 1987 and 33.3 MGD in 1991.

In order to compare the costs of staged expansion with construction of a full expansion, the capital and operating costs for each of the above alternatives over the 20 year planning period have been calculated using 1975 costs and are set forth in total present worth dollars as follows:

Alternative 3H: $32,886,000; Alternative 3H1: $31,999,000; Alternative 3H2: $31,616,000. Within the range of estimating accuracy the cost-effectiveness of the alternatives may be judged to be equal.

Another factor affecting the determination of design capacity to be considered includes the fact that, because of inherent design considerations, phased systems would be somewhat more complicated to operate and control.

Currently the per capita average annual contribution to the sewerage system is 135 gallons per day. The benefits of and potential for reducing this parameter are sufficient to merit considerable

attention. The benefits of such a reduction include improved treatment efficiency resulting in lower power and chemical requirements, lower operation and maintenance costs and increased design life of existing sewers. Because less water would need to be withdrawn from the Truckee River, the assimilative capacity of the river would be increased and river temperature may be decreased.

Although the most feasible measures for reducing per capita discharges are not known, they might include water supply metering, water supply charges based on water use and use of water conserving devices in new home construction. Implementation of such a program could take a number of years and could be accomplished while first stage plant construction is undertaken.

POSSIBLE MITIGATIVE MEASURES

In this section potential mitigative measures are presented for consideration by agencies responsible for implementation, the public, and reviewing agencies. While NEPA requires EPA to determine and discuss all impacts of alternative projects, EPA may only require as a condition of project approval, mitigation of those primary and secondary impacts which contravene a federal law, regulation or executive order. Other impacts and potential mitigative measures are recommended as to the local decision makers for their consideration. It is expected that, after review of these and other equally effective measures and after reviewing comments from the public and reviewing agencies, the City of Reno will contact agencies capable of implementing viable measures and solicit commitments for implementing specific measures. Primary impact mitigative measures will be incorporated into the construction plans and specifications and O&M Manual and secondary impact mitigative measures necessary to preclude violations of federal laws. Regulations, guidelines, or executive orders will be submitted to EPA in the form of adopted resolutions or ordinances. EPA will then make a judgment as to the significance of the remaining primary and secondary unmitigated impacts.

Primary Project Mitigative Measures

- Topography

  Construction corridors should, where applicable, be graded to original contours.

- Scenic/Aesthetic Characteristics

  Landscaping should be provided and maintained at the treatment plant site to be compatible with or enhance the surroundings.

  Removal of natural vegetation should be minimized.

  Storage and disposal facilities at Spanish Springs Valley should be developed to be compatible with or enhance the surroundings.

  Excavation and placement of pipes should be a rapid process in order to minimize the number of days that views are impaired. Care should be taken to provide early site restoration including vegetation, where required, following pipeline placement.

During construction and on-going maintenance, general clean up of trash and construction debris should be routine, with disposal in approved areas. Controls to reduce degradation of existing natural qualities of the site should receive a high priority.

Storage of construction equipment and materials should be limited to designated areas.

Uses of construction vehicles should be limited to assigned rights-of-way and haul roads.

Structures should be architecturally designed and landscaped so as to be compatible with their surroundings.

- Archaeology

Archaeological sites have been identified at the land disposal site in Spanish Springs Valley and along the west side of Spanish Springs Road. It is recommended, therefore, that a detailed archaeological survey be conducted of the proposed land disposal site in Spanish Springs Valley to determine the extent of necessary mitigative measures on these sites. The sludge and supernatant pipeline to Spanish Springs Valley should be located in the public right-of-way on the east side of the Spanish Springs Road, in which case no additional survey of this route would be required. If a route other than this is chosen as the pipeline route, then an archaeological survey should be conducted to properly choose the best location for the pipeline route.

A person qualified to recognize cultural resources should be present during all ground disturbance operations with the authority to stop construction and determine the significance of any finds that may be encountered and recommend appropriate mitigative measures to the National Park Service, the Nevada Historic Preservation Officer and the Advisory Council on Historic Preservation.

Construction contracts should specify that any uncovering of significant archaeological sites be reported immediately and that work be halted to determine the proper cause of action.

The value of the site should be determined in coordination with the National Park Service, the Nevada Historic Preservation Officer and Advisory Council on Historic Preservation prior to excavation of the resources to determine proper recovery or avoidance procedures.

Delays and costs attributable to necessary alignment changes and proper recovery of cultural resources should be addressed by change order procedures without time or cost penalty to the construction contractor.

Construction personnel should be encouraged to report possible cultural resource findings and should be instructed as to the nature and identifying characteristics of the resources that might be encountered.

- Resources

There is a potential to reuse sludge digester gas to produce power for treatment system needs.

Development and implementation of a water conservation program designed to reduce the quantity of water discharged to the sewer system such that plant efficiency might be improved and power and chemical requirements might be reduced would mitigate the anticipated impacts on water quantity and quality.

- Soils and Geology

Implementation of the following measures will mitigate the potential adverse geologic and seismic impacts reported in Chapter 4, which affect the treatment plant expansion, sludge and supernatant transmission pipelines and the interceptor sewer lines.

1) Install the sewer lines with reasonable setback distances from the top of hills and banks

2) Design the sewer line and its appurtenances with reinforcement as necessary to resist earthquake forces

3) Provide periodic maintenance, surveillance, and quality control during construction as well as during normal system operation

4) Proper monitoring could identify pipe settlement and allow for correction prior to any breakage. Frequent installation of valve structures along

the transmission line would provide emergency shutoff locations

5) Design slopes properly to avoid possible landslides at the treatment plant site

6) Minimize effects of expansive soil conditions by placing a thicker than normal bed of ground below the pipe or by installing the pipeline at greater than minimum depth requirements

7) Avoid exposure of all sewer lines under the river due to scour by requiring, in the pipe design, adequate cover below the river bed

8) Prevent damage to the interceptor sewer from landslides in the Lawton-Verdi area by conducting proper route selection surveys; in this way, unstable areas with potentially unstable material will be avoided

Alarm system should be installed in force mains to signal pressure drops during pumping to warn of broken or leaking pipes, such as could result during earthquakes or from subsidence.

- Surface and Groundwater Hydrology

Mitigative measures to prevent or retard environmental impacts on surface and groundwater include:

1) Prevent entry into surface waters of wash from equipment and waste materials such as petroleum products by designation of service areas and provision of waste containers.

2) Implement erosion control measures, where necessary, during plant construction and Spanish Springs sludge pipeline and disposal facilities construction and operation.

3) Installation of the proposed diffuser system to discharge the effluent into the Truckee River is recommended not to exceed 20 percent of the cross-sectional width of the river at the point of discharge in order not to create a chemical barrier to migrating fish species. Alternatively, flows could continue to be discharged into Swan Lake.

4) Construction of chlorine removal facilities or alternative disinfection facilities to reduce effluent toxicity to aquatic life.

5) Development and enforcement of a sewer use ordinance such that the discharge into the collection system of materials that are not susceptible to wastewater treatment would be prohibited or reduced to acceptable levels.

6) Restrict stream bottom substrate disturbance at points of river crossing to a minimum width. Avoid stream-crossing construction during period of extreme low flow to prevent damage to young trout and trout spawning activities that could be caused from construction sediment loading.

7) Develop and implement water quality monitoring programs for the Truckee River, and the Spanish Springs disposal area (should Concept I or III be selected) sufficient to determine the need for ammonia and/or nitrogen removal and the safe levels of sludge and supernatant application.

8) Proper design of supernatant and sludge pipelines such that exfiltration is kept to a minimum. Measures to reduce chlorine compounds and un-ionized ammonia to minimize effluent toxicity to aquatic life may be necessary to comply with discharge limitations that may be set forth in future NPDES permits.

- Vegetation

Impacts to vegetation communities in construction areas can be mitigated if the following measures are implemented:

1) Avoid river bank disturbance where possible, and re-vegetate or stabilize construction areas on disturbed river banks.

2) Revegetation should be accomplished with species common to the area whenever possible.

3) Top soil should be stockpiled and replaced following grading operations on cultivated and/or agricultural areas to facilitate revegetation.

- Fish and Wildlife

See Surface and Groundwater Quality for associated mitigation measures.

- Air Quality

Air quality impacts related to dust generated during or after construction activities can be mitigated by (a) keeping the construction site watered; (b) operating dirt haulage equipment at low speeds; (c) limiting grading operations on extremely windy days; (d) revegetation.

Internal combustion engines, both mobile and stationary, used at the construction sites should be provided with emission control devices. Internal combustion engines should bemaintained in a well-tuned condition.

All volatile liquids including fuels and solvents should be storedin closed containers. These liquids should be transferred by hoses provided with the air-tight connector.

Open burning of construction scrap and vegetation should be prohibited.

Sewer collection line odors, if a problem, should be eliminated byreducing sewage travel time or adding odor retarding measures.

If sludgeincineration is chosen it should be designated and operated to comply with the New Source Performance Standardsof the Washoe County District Health Department.

- Acoustic Environment

Maintain effective noise reduction devices on all construction equipment to limit noise to less than 86 dBA level at 50 feet to noise sensitive areas.

Residentsliving in areas adjoining the site should be notified what dates construction will occur in their area, so that they can plan their activities accordingly.

- Local Use of Population

Local ordinances together with OSHA and Nevada Industrial Commission Regulations shall be enforced to protect workers of the general public.

The reclaimed site should have adequate sites to provide a buffer zone to insure between the operation area and adjacent areas.

- Urban Systems

  Transportation

  To minimize traffic disruption caused by interceptor construction occurring within a traffic lane or crossing a street, proper traffic control procedures should be practiced particularly on Mill Street and one block of Virginia Street. At least one lane in each direction should be maintained if at all possible. Construction sites should be clearly marked. Motorists should be given early warning of upcoming construction activity so that alternate routes may be taken or vehicle speed appropriately adjusted. Where necessary clearly marked detour routes should be provided. Authorities responsible for emergency vehicle movement should be notified prior to closing a street or establishing a detour.

  Disruption of gas, telephone or electrical service due to construction should be as brief as possible. The service area should be notified if the disruption will be of any duration.

- Economy

  Where construction in streets adjacent to businesses is required, temporary access for foot traffic should be provided and early advice of such activity should be provided so appropriate plans may be made.

Secondary Impact Mitigation Measures

- Resources

  Encourage energy conservation through public education.

  Class I and II soils in rural areas should be preserved where possible for agricultural uses.

  Protect areas potentially needed for future park development from encroaching urban development.

  Energy conservation should be practical through improved machine efficiencies and adherence to recognized insulation conservation standards.

- Archaeology

The Cities of Reno and Sparks and Washoe County could each survey their portions of the proposed service area to determine the location of archaeological, historical, and paleontological sites.

The City of Sparks and Washoe County could each require proposed developers to submit an archaeolgoical survey for the proposed site.

Upon identification of a site in an area proposed for development with potential adverse impact, the land use agencies could require development to submittal of measures to mitigate the adverse effects.

To avoid possible vandalism or destruction of known sites the exact location of these sites should not be made public.

- Geologic Hazards

Use of zoning to limit and/or manage development in areas subject to hazards from flooding, seismic events and landslides.

Following determination of flood hazard zones in accordance with the Flood Disaster Act of 1974, participation in the HUD Floodplain Management Planning Program.

- Water Service, Demand and Conservation

Water Use: Public education to explain water conservation methods and benefits.

Encourage the use of water conservation devices for showers and toilets in existing homes.

Incorporation of water conservation devices (showers, toilets, draft restrictors) in new construction standards.

If water meters were to be permitted under crisis law, then water pricing could be made proportional to water use.

Encourage the use of vegetation which uses less than average amounts of irrigation water.

- Water Quality

  Incorporation of erosion control measures into building permits.

  Use of zoning to limit and manage development areas particularly susceptible to erosion, such as along the river and stream margins, on slopes greater than 15 percent and in inaccessible fire-prone areas.

  Incorporation of urban runoff controls into land use plans and construction criteria, such as storm flow detention basins, management of large animal wastes, and litter control ordinances.

- Air Quality

  Secondary impacts on air quality are associated with population growth. These impacts can be mitigated by implementing the following measures:

  Encouraging mass transit system on an intra-city and inter-city basis to reduce vehicle use (oxidants, carbon monoxide [CO]).

  Encourage elimination of barriers to constant speed traffic (oxidants, CO).

  Frequent, regularly scheduled street cleaning, using mobile vacuum cleaning equipment (particulate matter).

  Paving or chemically stabilizing unpaved roads (particulate matter).

  Reduced speed limits on unpaved roads (particulate matter).

  Encouraging priority parking and/or reduced rates for car pool vehicles (oxidants, CO).

  Encourage use of bicycles and construct bicycle racks and storage facilities at road employee (oxidants, CO).

  Development of a state vehicle inspection program with mandatory maintenance/repair for those vehicles failing the inspection (oxidants, CO).

Facilitate mass transit by cluster development, and in filling of passed areas on a priority basis (oxidants, CO).

Limit off road vehicles on public lands to designated public areas (particulate matter).

The Cities of Reno and Sparks as well as Washoe County will participate in the development and implementation of the State Air Quality Maintenance Plan (particulate matter).

Improve stationary source monitoring and enforcement if necessary (oxidants, CO, particulate matter).

Control of sand and gravel pit aggregate and haul road emissions if necessary (particulate matter).

Substitute free bus tokens in place of parking validations to encourage public transit ridership (oxidants, CO).

Improve traffic flow (synchronized traffic signals, one way streets, etc.) (oxidants, CO).

Install vapor recovery control for underground petroleum storage tanks at individual gasoline stations (oxidants).

- Urban Systems

The WCOG should plan to develop early needs for schools, roads, transit services, solid waste collection and disposal, police and fire protection, water and sewer lines, postal services, health care, recreation, libraries, and government services. These needs should be incorporated into the land use plans so that the rate form and location of development may be consistent with available public funding.

PROBABLE SIGNIFICANT ADVERSE IMPACTS WHICH CANNOT OR ARE NOT CURRENTLY PROPOSED TO BE MITIGATED

This section cannot be completed until a project is selected with appropriate mitigative measures. The Final EIS will, however, discuss these subjects in detail since they will represent a major factor in the decision to fund a selected project.

Adverse impacts differ in their susceptibility to mitigation. Most primary construction and operational impacts can generally be reduced to acceptable levels with the principal determinant being the level of expenditure of public funds. The level of mitigation finally implemented will therefore reflect the value assigned the resources potentially impacted and the relative priority of these resources within the many competing demands on limited public funds. Other primary impacts can be reduced in extent and duration but not entirely avoided.

It should be noted that the full project impact would not necessarily occur the day the facilities became operational. This is particularly true for the secondary impacts associated with population growth. Land use planning, as the chief determinant of the level, location and timing of development, is capable of resolving most secondary impacts; however, there is a danger that infrastructure investments and piecemeal development in advance of completed plans may direct the outcome or foreclose planning options. The absence of completed land use plans, especially in the Lawton-Verdi corridor, capable of addressing the design population to be served by this project complicates any commitment to specific secondary impact mitigative measures since the impacts can only be generally described without knowing the form and location of this development. The mitigation of secondary impacts is generally more difficult than for primary impacts because it may involve changes in basic public policy and in life styles of residents. Again, the level of mitigation finally implemented will reflect the value assigned the resources being protected and their relative priority among other goals and needs.

Because of these limitations, the avoidable impacts are identified by category only.

Primary impacts that can be sufficiently mitigated to all but a minor degree:

- Groundwater effects from sludge and supernatant application
- Temporary water quality effects of turbidity associated with stream crossings
- Temporary nuisance effects of construction dust and noise
- Water quality effects of erosion
- Odors associated with operation of the JWPCP and sludge disposal operations
- Temporary residential, commercial, traffic and recreational disturbances associated with construction
- Destruction and/or disturbance of vegetation
- Aesthetic disturbance associated with construction
- Disturbance of archaeological sites due to sludge disposal activities

Primary impacts that can be mitigated to all but a moderate degree:

- Land consumption associated with use of 5 acres for the plant site and 1500 acres for the sludge disposal site
- Emissions associated with operation of a sludge incinerator
- Consumption of power, materials, and chemicals associated with construction and operation of the facilities.
- Construction and operation/maintenance costs of the facilities

Secondary impacts that can be mitigated to all but a minor degree:

- Development of hazard areas including floodplains and seismic zones
- Generation or dissemination of unpleasant odors
- Air quality degradation

- Consumptive use of water from the Truckee River

Secondary impacts that can be mitigated to all but a moderate degree:

- Consumption of natural resources
- Consumption of agricultural and open space lands
- Consumption of wildlife habitat
- Requirement for additional urban services with associated costs

RELATIONSHIP BETWEEN LOCAL SHORT TERM USES VERSUS MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY OF THE ENVIRONMENT

The proposed project involves the use of resources which, once committed, foreclose the option for other uses; the project will create beneficial and adverse impacts, both long term and short term. The most important of these short term impacts are the potential effects on aquatic biota from siltation, and the potential to damage or destroy archaeological resources, particularly along the Spanish Springs line route. Both of these impacts are sufficiently mitigatable that serious damage can be avoided. The principal beneficial project impacts are improved levels of domestic wastewater treatment and water quality conditions in the Truckee River.

Long term impacts are, for the most part, a tradeoff between direct long term beneficial impacts and secondary adverse impacts. The three projects, on a whole, will improve the sewage collection and treatment system, improve upstream surface and groundwater conditions and will reduce the phosphate levels and eutrophication of the lower Truckee and Pyramid Lake system.

Secondary adverse impacts are all related to an increase in population and urbanization accommodated by the project. Several of the air and water quality parameters will increase as a result of future population levels. Future developments will create new demands for urban systems, including facilities, utilities, services and energy. Urbanization will create pressures on the region's flora, fauna, archaeologic resources, scenic, park and open space system. Debt servicing for the project will probably require an increase in sewer user fees and charges.

The beneficial secondary impacts are the jobs created as a part of future urbanization and the total spendable income generated from this level of employment, as well as accommodating a portion of the growing national population.

The three projects, themselves, represent a permanent commitment of resources of just under $30 million, in addition to about $1 million in annual O&M costs. No other direct commitment of resources is required. However, the facility will permit urbanization of approximately 20 square miles. This secondary effect, which is subject to project-by-project approval by elected officials and staff, will require the commitment of substantial resources in the future.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction of sewage treatment and sewage conveyance systems requires the irreversible, irretrievable expenditure or use of energy, material, land and manpower and depreciation of capital goods (equipment). Construction also poses certain risks to the environment and to construction workers and residents, some of which may be irreversible commitments.

Continued operation and maintenance of the sewer system and equipment requires expenditures of energy, materials, manpower and depreciation of capital.

Construction-Related Resource Consumption

Material, energy, labor and right-of-way land resources required for the Joint Water Pollution Control Plant, the Cross-Town Sewer (Mill Street Interceptor Extension) and the Lawton-Verdi Interceptor are represented by the capital costs of their respective alternatives, detailed in Chapters 5 and 6.

Operation-Related Resource Consumption

After construction, further irreversible, irretrievable commitment of resources derives from three sources: 1) operation and maintenance (O&M) of the facilities; 2) the potential for accident or damage to the system; and 3) the indirect commitment of resources which is facilitated by the project.

Urbanization accommodated by the project will require the irreversible, irretrievable commitment of substantial land, material, labor and energy resources and, for continual operation, labor, materials and energy. In the process, vegetation, wildlife, scenic, archaeologic and recreational resources will be irretrievably consumed or lost. Current agricultural production will be irretrievably converted to urban uses. Domestic water will consumed at a greater rate, although it is a recycling resource.

PUBLIC CONCERNS AND UNRESOLVED ISSUES

Throughout preparation of the EIS, the consulting team, the City of Reno and the Environmental Protection Agency have identified certain key issues of concern to the public who have an interest in the Truckee Meadows and surrounding area. These issues were emphasized and clarified in two public information workshops held during preparation of this document at the Reno City Hall, the first in March and the last in October, 1976. These concerns, which are the subject of the EIS, are listed below.

- Compatibility of sewer service extension with articulated general planning goals;
- Rationale for improved regional waste treatment and collection;
- Growth accommodation resulting in air quality degradation;
- Groundwater consequences of sludge supernatant disposal in Spanish Springs Valley;
- Sewer construction impacts within the upper Truckee River Canyon (to Verdi);
- Water quality influences on the riverine fishery;
- Water quality/quantity ramifications of the proposed project on Pyramid Lake and the lower Truckee River
- Water supply/conservation
- Implications of proposed project alternatives for construction employment and the general economy.
- Implications of accommodated population growth and extended urbanization for life style of residents.
- Distribution of and character of urban development in Truckee Meadows and Truckee River Canyon.

A second area of concern is in regard to a number of issues which are not possible at this time to resolve. Some of these are external to the proposed project; others await further study or work by other agencies. In any lengthy detailed study of a large complex system such as the Reno-Sparks Joint Water Pollution Control Plant and associated sewerage system, it is rarely possible to resolve all the issues prior to making major decisions. Future wastewater treatment program planning most likely will benefit from resolution of some of these issues, which are listed below.

- Benefits, necessity, methods and degree of removal of potentially toxic and biostimulatory forms of nitrogen from the Truckee River that are currently present in the Reno-Sparks JWPCP discharge.

- Completion and implementation of the Washoe Council of Governments Areawide Wastewater Management Plan, which will address diffuse source pollution from Steamboat Creek and the North Truckee Meadows Drain.

- Selection of Project: a treatment capacity and a treatment configuration which is cost effective and which minimizes environmental degradation and maximizes environmental enhancement.

- Character, density and distribution of future urban development in Truckee Meadows and particularly in the upper Truckee River Canyon.

LIST OF REFERENCES

S-1 SEA, Inc. Reno Cross-Town Interceptor, October 30, 1975, Reno, early 1976, including Appendices A-E.

W-1 Walters Engineering and Metcalf and Eddy. Unified HUD-EPA Area-wide Water Quality Management Plan for Washoe County, November 1974.

ADDENDA

PART II

EXISTING ENVIRONMENTAL SETTING

CHAPTER II EXISTING ENVIRONMENT

CHAPTER III LOWER TRUCKEE RIVER - PYRAMID LAKE BASIN SYSTEM

CHAPTER IV URBANIZATION OF THE SERVICE AREA

The second section describes in detail the natural physical, man-made and socio-economic aspects of the environment as they occur in the Truckee Meadows region. This section is divided into three main parts which deal with the regional aspects of the environment, the site environs of the treatment plant, the downstream lower Truckee River, Pyramid Lake and Spanish Springs Valley areas, the site environs of the Cross-Town Sewer corridor and the site environs of the Lawton-Verdi Interceptor corridor.

CHAPTER II

EXISTING ENVIRONMENT

INTRODUCTION

In general, the existing environment will be the standard against which future changes--accommodated or generated by any of the array of proposed actions--will be contrasted. This environmental baseline provides a reference from which the beneficial and detrimental effects of construction and/or operation of each project alternative are evaluated.

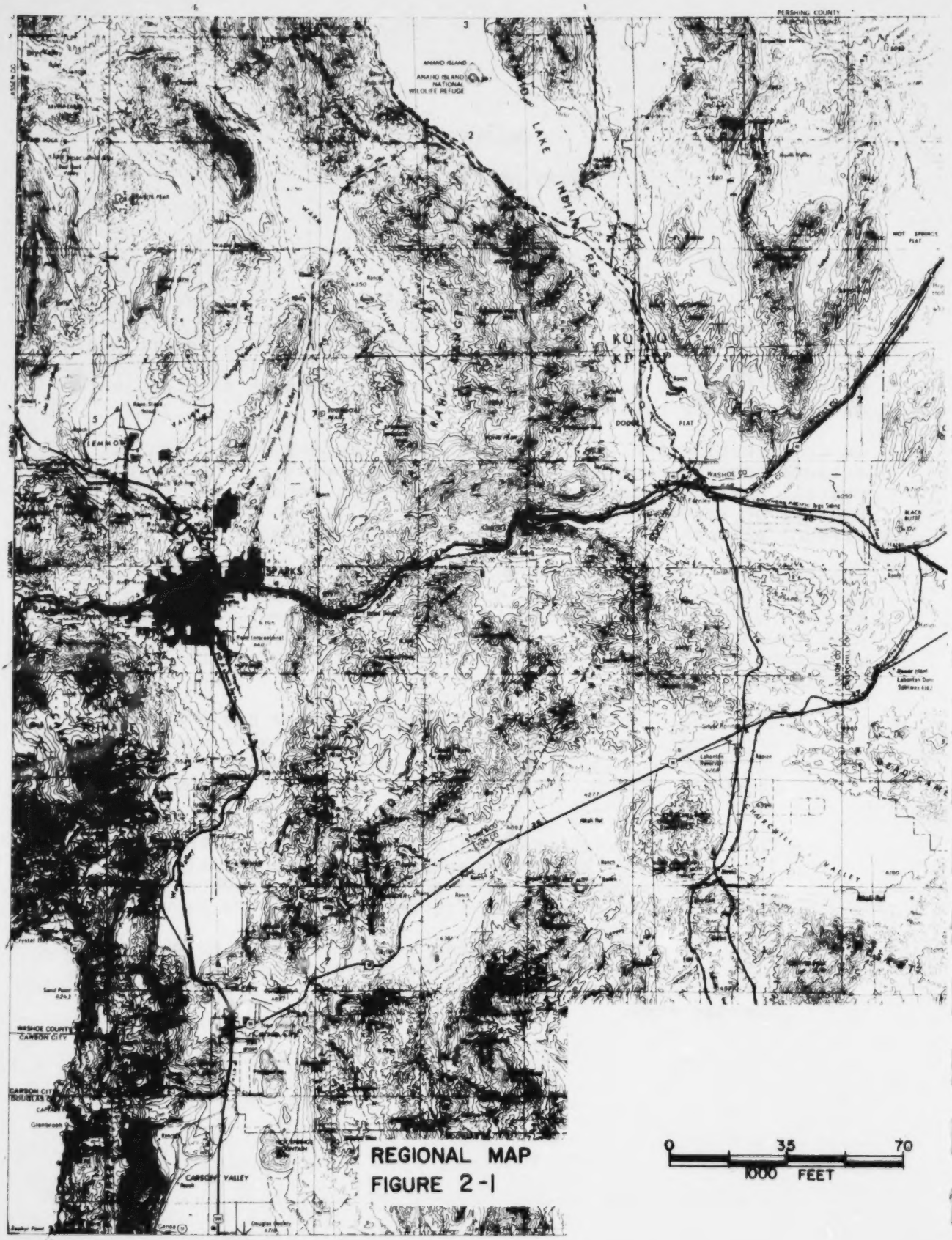
In constructing the framework for environmental evaluation, it is advantageous to provide a segregation of topics so that first, an overall environmental setting is portrayed; second, the specific area to be served is identified; and finally, the tributary (downstream) effects are traced to their points of impact.

The intensity of discussion and the specificity of information provided will vary with each of these topics. As a guide to the reader, then, and as a synopsis of the macro-to-micro scale of environmental evaluation contained in this report, the following geographic categories are used to index existing environmental conditions.

- The region encompassing the Truckee River Basin and extending from the Sierra Nevada Crest above Lake Tahoe eastward to and including Pyramid Lake and the adjacent areas of Lemmon Valley, Sun Valley, Spanish Springs Valley and Washoe Valley (see Figure 2-1).

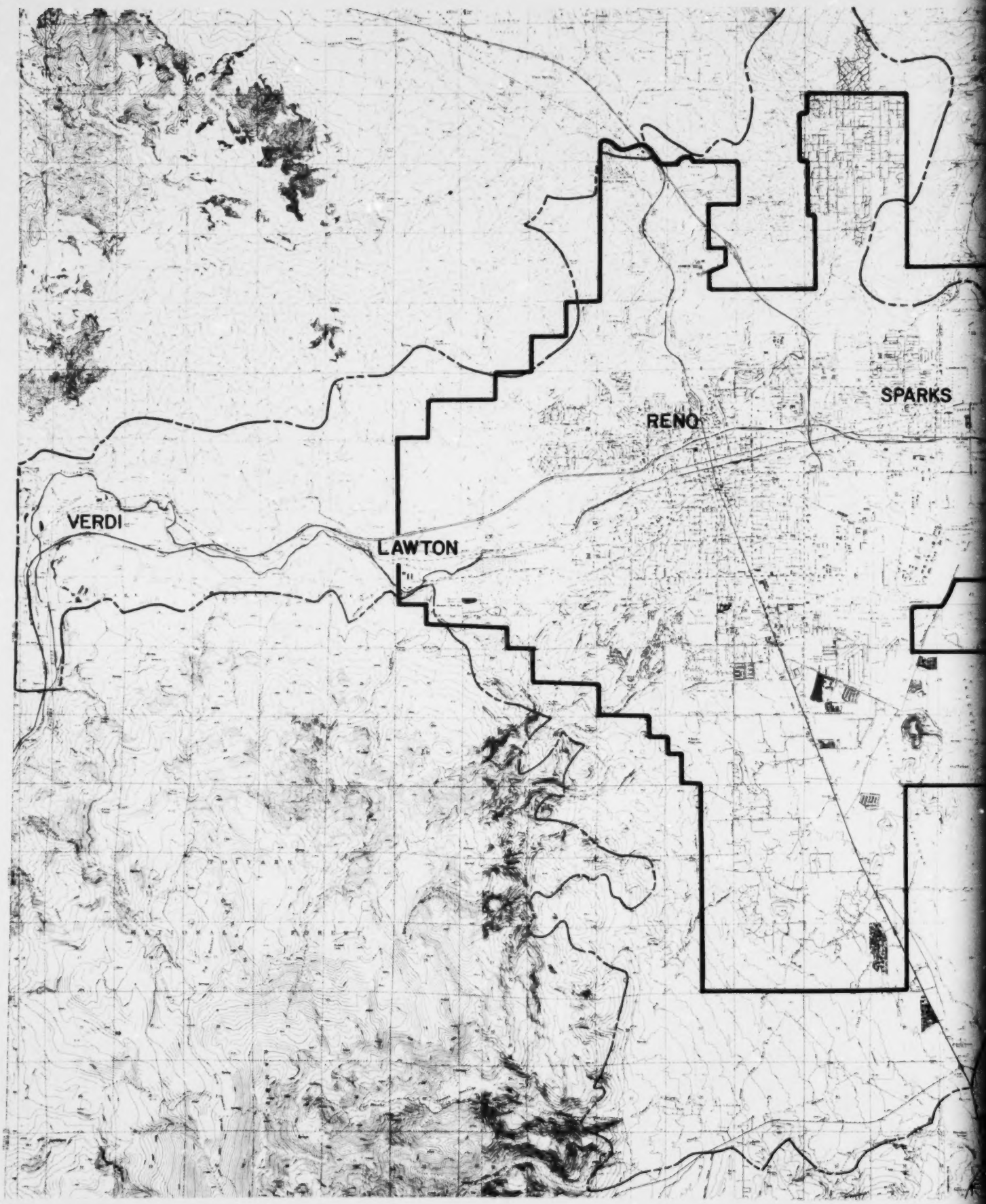
- The service area essentially contained within the urban limit line of the Reno-Sparks area and comprising the lower lands extending from the California-Nevada state line eastward to include Truckee Meadows (see Figure 2-2).

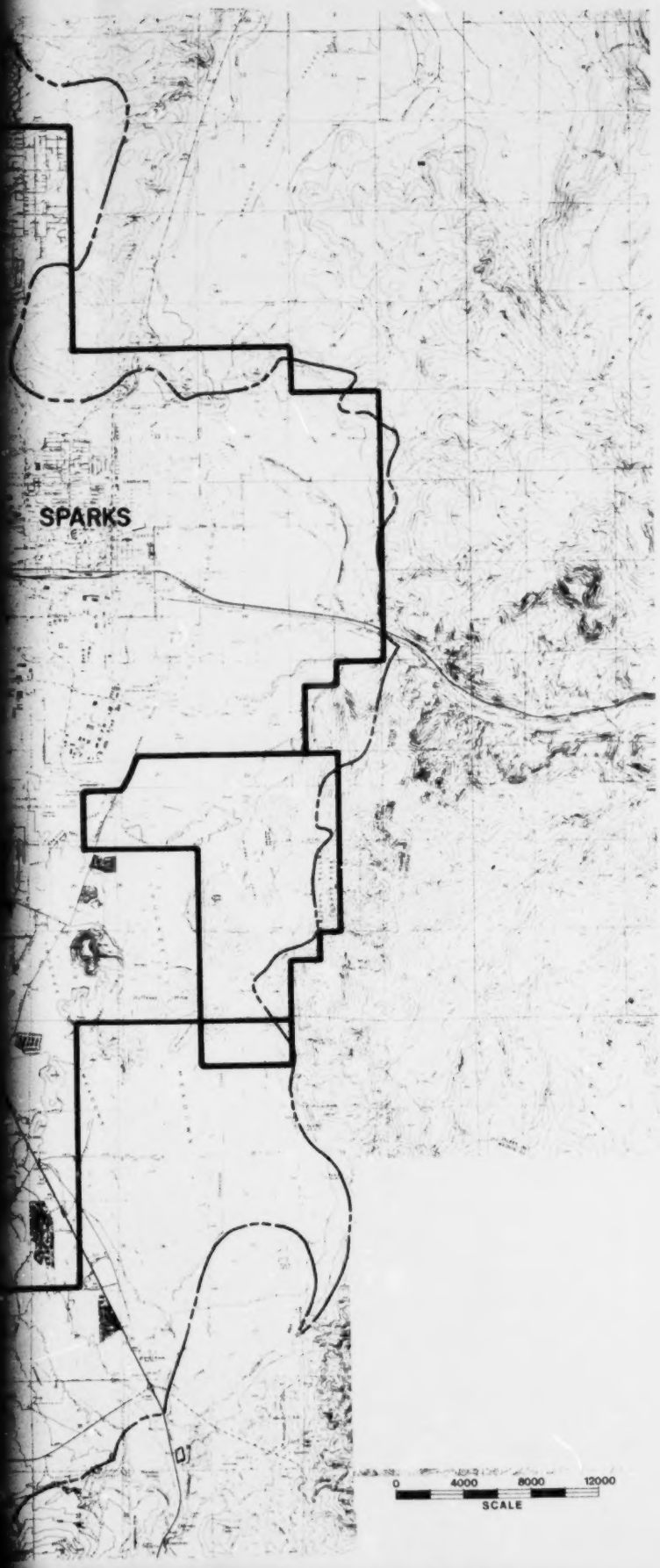
- The site environs consisting of and relating to the specific site locations of the proposed project facilities and the areas of construction impact all of which are within the service area.



REGIONAL MAP
FIGURE 2-1

Reproduced from best available copy.


SPARKS
RENO
VERDI
LAWTON



SERVICE AREA MAP

FIGURE 2-2

- The lower Truckee River from Vista, the point where the river leaves Truckee Meadows, eastward to Pyramid Lake and including the Lahontan Diversion at Derby (see Figure 2-1).

As an additional guide to the reader, the regional category, or overview, is the first subject matter of this chapter, and includes those aspects of the environment which are so significant in the macro sense that they provide the overall setting for the proposed actions but are not subject to change by those actions. These regional factors, comprising the perimeter of the environmental evaluation framework, are discussed on the following pages and are not encountered again in subsequent chapters of this report.

By contrast, those sub-regional factors influenced by the proposed actions, either in a direct (primary) or indirect (secondary) manner, are discussed in this chapter on the existing environment and in subsequent chapters where impacts, mitigating measures, productivity and resource commitments are identified in relation to those factors.

GENERAL PHYSICAL CHARACTERISTICS

Regional Location

The regional environment is seen as including the Truckee River Basin from Lake Tahoe to Pyramid Lake, the eastern slopes of the Sierra Nevada and the Carson, Virginia and Pah Rah mountain ranges. The total area includes parts of Washoe County, Nevada, and Placer and Nevada counties in the State of California.*

Washoe County, ranking seventh in size when compared to Nevada's seventeen counties, is located in the northwest portions of the State of Nevada and is bordered by California on the west, Oregon on the north and Humboldt, Pershing, Churchill, Lyon, Storey and Ormsby counties on the east and south. Washoe County encompasses 4,074,240 acres of which the southern one-sixth, approximately, is tributary to the Truckee River. Figure 2-1 depicts the relationship of Washoe County to the State of Nevada and to adjacent counties.

Topology/Hydrography of the Truckee River Basin

The Truckee River begins at Lake Tahoe on the western shore near Tahoe City. Lake Tahoe is an irregular oval about 22 miles long and 12 miles wide. The lake at maximum elevation has a surface area of

---

*Tahoe Basin

Preceding page blank

122,628 acres. Its greatest measured depth is 1,645 feet, its shoreline measures about 71 miles in length and its volume has been estimated at 125 million acre-feet. Sixty-three separate watersheds flow into the lake contributing, on the average, 307,900 acre-feet per year to the lake. The outflow of Lake Tahoe to the Truckee River is regulated by a dam at Tahoe City, which is operated to maintain the level of Lake Tahoe between 6,223 feet and 6,229 feet(A-1). The Truckee River begins at the outlet of Lake Tahoe and traverses the Truckee Meadows in north and easterly directions approximately 119 miles to Pyramid Lake

The river basin has no outlet to the sea. The main tributaries below Lake Tahoe are the Little Truckee River, and Prosser, Donner, Martis and Steamboat creeks. Numerous intermittent tributaries along the stream contribute to flood flows during periods of general rain and snowmelt. Below Verdi, at the mouth of the Truckee River Canyon, the river enters a vast meadow, the western and northern sections of which are occupied by the incorporated cities of Reno and Sparks. Known as Truckee Meadows, the area is 4,500 to 4,300 feet in elevation and is poorly drained. Though urban development is encroaching on the Meadows, it is still partially used for agriculture. Below the Vista Reef, an igneous dyke which is the "outlet works" for Truckee Meadows, the river enters a steep canyon and flows eastward to Wadsworth where it emerges and passes into a valley before turning northward through the Paiute Indian lands to Pyramid Lake.

The Truckee River terminates at Pyramid Lake which is the largest body of water entirely within the State of Nevada. This lake is an irregular oval about 30 miles long varying from 7 to 11 miles wide. The lake surface elevation is 3,789 feet and has as approximate area of 109,000 acres. Its capacity has been estimated at 20.5 million acre-feet and approximately 250,000 acre-feet per year flows into Pyramid Lake from the Truckee River. Above Vista, which is at the outlet of Truckee Meadows the river drains about 1,430 square miles of mountainous terrain, including about 500 square miles above the Lake Tahoe outlet. Most of the runoff from the basin originates on the eastern slopes of the Sierra Nevada.

The Truckee River is subject to extensive regulation. The major storage reservoirs below the dam at Tahoe City include Donner Lake, Independence, Prosser, Stampede and Boca Reservoirs, all on tributaries to the river. Diversions from the Truckee River include irrigation and use in the Truckee Meadows area for farming and for the municipal water supply of Reno and Sparks. The largest diversion of water from the Truckee River occurs at Derby Dam below Truckee Meadows where an average of 250,000 acre-feet per year (as measured over the period from 1918 to 1970) has been diverted. This water is then transported

via the Truckee Canal to Lahontan Reservoir on the Carson River for irrigation use along the canal and in the Newlands Project near Fallon, Nevada. This water irrigates approximately 63,000 acres through the use of some 900 miles of canals, laterals and drains.

Service Area Topology/Hydrography

The service area for the proposed facilities can be visualized as a midcourse node in the thread of the Truckee River between Lake Tahoe and Pyramid Lake. This area includes the previously described Truckee Meadows and adjacent valleys and the upstream narrowing approach to the Truckee River Canyon in California. This riverine environment, as it continues upstream, is a narrow, glacial and water-canyon which is at right angles to the steep ridges of the Sierra Nevada. As the Truckee River enters Nevada from California, the canyon is left behind and the river course winds through a glacial terrace area first passing the community of Verdi and then the resort area at Lawton before emerging into the broad expanse of Truckee Meadows at Chalk Bluff.

Truckee Meadows lies in the valley formed between the Carson Range of the Sierra Nevada on the west and the Pah Rah and Virginia Mountain Ranges on the east. The ridges of the Pah Rah and Virginia Mountain Range are 1,000 to 1,500 feet above the valley floor. The Sierras on the west loom nearly 4,000 feet above the floor. Mount Rose is the highest peak in the area at 10,776 feet. There are several valleys north of Reno which are also considered in this report; namely Sun Valley, Lemmon Valley and Spanish Springs Valley. These valleys are separated by hills and ridges but are all in close proximity to each other and to Reno. The floor of Sun Valley is developed in an urban grid but is very low density and is included in the service area for the year 2000. The Stead area of Lemmon Valley has been annexed to Reno and is in the ultimate service area, but is not included in the year 2000 service area. Spanish Springs Valley is the site proposed for land reclamation and irrigation from the Vista Treatment Facility. Otherwise Spanish Springs Valley is not affected by the year 2000 service area.

South of Truckee Meadows and separated from it by Steamboat Hills is Washoe Valley. Washoe Lake lies in the center of the valley and is the water source for Steamboat Creek. Washoe City and New Washoe City are located in Washoe Valley. The largest tributary to the Truckee River in the study area is Steamboat Creek which drains the southern and eastern part of Truckee Meadows and enters the Truckee River near Vista. Tributaries to Steamboat Creek by way of Boynton Slough, originate on the northeastern slopes of Mt. Rose. These streams flow northeasterly to a point east of

South Virginia Street where Evans Creek joins Dry Creek. Dry Creek enters Boynton Slough north of East Peckman Land, and Boynton Slough in turn joins Steamboat Creek. Hunter and Alum Creeks originate on the northern slopes of Mt. Rose and flow northerly in steep narrow canyons to enter the Truckee River west of Reno. Peavine Creek flows southeasterly from Peavine Mountain to the outskirts of Reno, where it enters the drainage system. North Truckee Drain consists of a natural channel now largely improved and realigned to provide better drainage of Spanish Springs Valley and the northeasterly sector of Truckee Meadows. It joins the Truckee River near Vista. With the exception of Steamboat Creek, most of the tributary streams in the vicinity of Reno are intermittent.

Drainage areas at various points in the service area are given in Table 2-A.

TABLE 2-A

DRAINAGE AREAS

Location	Drainage Area In Square Miles
Truckee River at Reno	1,067
Steamboat Creek above mouth	187
Dry Creek at East Peckham Lane	14
Evans Creek at East Peckham Lane	10
Alum Creek at Truckee River	7
Hunter Creek at Truckee River	12
Peavine Creek at storm drain entrance	4
North Truckee Drain at Interstate 80	92
Truckee River above Vista	1,429

Specific Site Locations

The site locations considered to be occupied by project facilities and areas of project impact include:

- Wastewater treatment plant, sludge disposal site, treated water disposal area, land reclamation and irrigation site
- The Reno Cross-Town Sewer route
- Verdi-Lawton Interceptor route

The treatment plant sludge disposal site and treated water disposal area are all located east of urban Reno and Sparks downstream on the Truckee River. The proposal under consideration is concerned

with expansion of existing facilities in the area known as Vista. One alternative under consideration would pump treatment process wastes north to a land reclamation and irrigation site in Spanish Springs Valley (see Chapter 5).

Chapter 5 depicts the route of the Reno Cross-Town Sewer. This route is intended to supplement an existing interceptor sewer serving the central downtown Reno area.

The Verdi-Lawton Interceptor would serve existing and potential urban developments in Truckee River Canyon from the California border east to the Reno City limits as indicated in Chapter 5.

SCENIC, RECREATIONAL AND CLIMATIC VALUES

Introduction

As described on the previous pages, the Truckee River Basin encompasses as its upstream origins the Lake Tahoe Subbasin and other alpine valleys along the east slope of the Sierra Nevada Crest: chiefly the watersheds of Five Lakes Creek, Squaw Creek, Donner Creek, Prosser Creek, Martis Creek and the Little Truckee River, all in California. There is ample descriptive material concerning noteworthy alpine grandeur of the area. Discussion of the scenic and recreational quality of the area is an integral part of the Final Environmental Impact Statement For North Lake Tahoe - Truckee River Basin, Wastewater Treatment and Conveyance System (E-2) published in 1974. To avoid duplication of the material presented in that report, the regional discussions of values in this section purposely do not include the Upper Truckee-Lake Tahoe areas in California above the Truckee River Canyon. The overwhelming aesthetic nature of this area is properly evaluated with respect to the urban growth and recreational use trends reported in the Tahoe-Truckee EIS.

Regional Environment

The region is overwhelmingly natural in appearance and embraces a remarkable transition in perceived character from alpine to desert environments. While the works of man impact a modest part of the whole, man-made influences tend to stand out because they are visually prominent as exceptions to the natural scene. The limits of the region are well defined by the mountain ranges which tower over the canyons and valleys through which the Truckee River passes. The rugged topography has tended to limit the transportation routes and urban clusters to the valley floors. Consequently, the scenic values most available to those who inhabit or travel through the region are of mountains close at hand while the scale of those mountains testifies to man's insignificance compared to that of nature.

Scenery is abundant and diverse and minutes away from any populated center one can experience solitude. Streams originating in alpine meadows descend through the forested eastern slopes of the Sierra Nevada to the desert. In the lowlands, the scars of the Ice Age are to be seen. Traces of ancient Lake Lahontan can be found. The lake bars, spits and wave cuts are readily apparent. From these traces of ancient history we know that subsequent lack of moisture caused lower life forms to develop unusual modifications to survive in the harsh desert environment. This partially explains the abundance of unusual plant and animal species.

Most of the desert's plant and animal life forms survive drought in a state of hibernation. When the rains come these organisms spring into their life functions at a rate that would compare to watching time lapse movies. In the mountains, where moisture is more dependable, vegetation is more diverse and higher forms of animal life exist.

Vistas are continually changing with the seasons. While summer is usually clear and sunny, high cumulus clouds frequently develop over the mountains often attaining massive proportions which add variety to the scene. In the fall, splotches of brilliant and intermingling foliage colors provide a spectacular display, followed by deep snow and the frosts of winter. As winter recedes, with snow remnants clinging to the high mountain peaks and ridges, the spring flower show begins at the lower elevations. A potpourri of changing vistas meet the eye throughout the region.

Pyramid Lake is regarded by many naturalists as the most beautiful desert lake in the United States. A number of physical features in and near the lake are peculiar to this basin and give the area a special identity. Of importance are the unusual calcium carbonate formations known as "tufa" seen in many shoreline areas. It is a solitary tufa formation rising from the lake on the east side from which the lake takes its name. Picturesque needle rocks on the northwest shore are also important landmarks. Since little of the area in the vicinity of the lake has been disturbed, most of the environment remains in its natural state.

Area Environment

The scenic environment in the vicinity of Reno-Sparks represents an exceptional natural resource. The Truckee River Canyon, the eastern approach to Donner Pass, is a study in rugged beauty. The sharp granite ridges of the canyon are rimmed by conifers and deciduous trees which lend visual interest to the landscape. The Truckee River, emerging as one of the urban area's most dramatic assets, descends the length of the canyon eventually running through the Reno-Sparks urban area.

Several high desert valleys--including Truckee Meadows, Spanish Springs Valley, Sun Valley, Lemmon Valley and Washoe Valley--also constitute exceptionally beautiful scenic resources. At present, urban sprawl is beginning to reach into these desert valleys and the pattern of this growth represents a potential threat to the survival of these unique scenic resources. This problem has been acknowledged by such local groups as the Design Committee of the Blue Ribbon Task Force (B-12) and efforts to preserve the scenic beauty are being considered at the present time.

Specific Site Environments

The JWPCP stands out in an area which is otherwise natural in appearance. This facility is housed in a distinctive brick and concrete structure set behind a spreading carpet of grass, surrounded by ponds or sludge drying basins contained by earth berms. The Cross-Town Interceptor is proposed to run through an area of intense development in downtown Reno. The downtown area is a tight urban pattern sprinkled with high rise structures which gives the core area a clear identity. This is in contrast to the rest of the community which is low in profile. While many areas of downtown are exciting with flashing lights, bright colors, people and action, one also sees dilapidated buildings, few amenities and vast areas of surface parking.

The project route of the Verdi-Lawton Interceptor generally follows the alignment of the Truckee River. The area is rural in character dominated by the towering Sierra Nevada Mountains. The Truckee River is a common theme to the area and an important visual asset. The vegetation is in transition from the beautiful high mountain growth to the valley desert sage. Much of the developed and developable land is in a narrow valley which parallels the Truckee River. The steep slopes of dramatic terrain define this portion of the service area.

Recreation Setting

The Truckee River Basin has outstanding natural recreation and scenic resources. Climatic conditions in the basin vary from semi-arid in the valleys, to sub-humid-arctic along the crest of the Sierra Nevada. The basin has two distinct natural recreation landscapes. These are defined as follows:

- Sierra Nevada Recreation Landscape

  The Sierra visitor enjoys awesome scenery in the typically high and very rugged terrain. From Lake Tahoe northward, the slopes are more gentle, the canyons not as precipitous,

and the forests are denser and greener than in the southern portion. Heavy winter snowfall in the Sierra creates ideal conditions for winter sports as indicated by the heavy recreation use at numerous resorts. In the spring, the snow melts slowly keeping the streams flowing, filling hundreds of lakes and providing excellent fishing and other water-oriented recreation opportunities. Much of the Sierra Nevada is under federal ownership and although it provides thousands of recreation days, it still has a vast potential for additional public recreation use.

- Desert and Desert Mountain Recreation Landscape

This is the largest of the recreation landscapes. It has a hot dry climate in summer and a cold relatively dry climate during the winter. The area has become increasingly popular with those who want to experience the pleasures of the desert's colorful, intriguing, and seemingly boundless vistas and incomparable solitude. For the novice, there is much to be learned about the desert's unusual and very specialized flora and fauna. The desert region is most attractive to visitors during the winter and spring months, when many other areas have limited recreation. The largest public landowner in this landscape is the Bureau of Land Management which administers more than 60 percent of the area. The majority of the private land recreation potentials are also in this landscape.

Table 2-B lists visitor-days at recreation sites in the state. Table 2-C lists visitor-day attendance by hydrographic regions. Water related recreation in Washoe County represents 46 percent of the total attendance at recreation sites in Nevada. The Truckee River hydrographic region receives over 50 percent of the total state attendance. Table 2-D lists 1970 recreational visits by site type. Over 9 million visits occurred and generated over 18 million dollars, an average of $1.94 per visit. Table 2-E lists visitor expenditures at Warrior Point zones determined by distance between recreational sites and visitors' place of residence. These distance zones were:

1 0 to 25 miles (road distance)

2 25 to 50 miles (road distance)

3 50 to 200 miles CAL and NEV (air distance)

4 Rest of CAL and NEV

5 All areas outside of CAL and NEV

TABLE 2-B

TOTAL VISITOR-DAYS ATTENDANCE AT RECREATION SITES FOR RESIDENTS AND NONRESIDENTS BY COUNTY, 1970

County	Resident Visitor-Days	Resident Percent	Nonresident Visitor-Days	Nonresident Percent	Total Use
Carson City	330,098	52.9	293,329	47.1	623,427
Churchill	243,965	84.5	44,747	15.5	288,712
Clark	3,872,496	60.2	2,560,984	39.2	6,433,480
Douglas	803,689	39.2	1,244,341	60.8	2,048,030
Elko	325,738	70.0	140,160	30.0	465,898
Esmeralda	15,626	70.5	6,530	29.5	22,156
Eureka	17,985	59.3	12,340	40.7	30,325
Humboldt	91,031	59.7	61,485	40.3	152,516
Lander	29,870	44.1	37,805	55.9	67,675
Lincoln	132,937	71.8	52,236	28.2	185,173
Lyon	185,760	87.7	26,083	12.3	211,843
Mineral	98,301	73.5	35,445	26.5	133,746
Nye	114,793	91.7	10,431	8.3	125,224
Pershing	115,095	76.2	36,015	23.8	151,110
Storey	3,774	98.7	50	1.3	3,824
Washoe	7,730,147	79.3	2,012,317	20.7	9,742,464
White Pine	366,610	73.5	131,836	26.5	498,446
TOTAL	14,477,915	68.3	6,706,134	31.7	21,184,049

Source: (S-5)

TABLE 2-C

TOTAL VISITOR-DAYS ATTENDANCE AT RECREATION SITES FOR RESIDENTS AND NONRESIDENTS BY HYDROGRAPHIC REGIONS, 1970

Hydrographic Region	Resident Visitor-Days	Percent	Nonresident Visitor-Days	Percent	Total Use
Northwest	11,707	82.6	2,465	17.4	14,172
Black Rock Desert	26,465	81.4	6,037	18.6	32,502
Snake River	99,328	70.0	42,834	30.0	142,162
Humboldt River	400,063	69.8	173,229	30.2	573,292
West Central	4,065	95.0	215	5.0	4,280
Truckee River	8,625,317	71.5	3,439,077	28.5	12,064,394
Western	5,000	100.0	0	0	5,000
Carson River	545,925	82.8	113,135	17.5	659,060
Walker River	184,811	70.2	78,508	29.8	263,319
Central	572,758	63.2	333,991	36.8	906,749
Great Salt Lake	35,653	50.7	34,627	49.3	70,280
Escalante Desert	0	0	0	0	0
Colorado River	3,945,882	61.4	2,481,356	38.6	6,427,238
Death Valley	20,941	96.9	660	3.1	21,601
TOTAL	14,477,915	68.3	6,706,134	31.7	21,184,049

Source: (S-5)

TABLE 2-D

1970 RECREATIONAL VISITS BY SITE TYPE

County	Type of Site	1970 Total Visits	Value of One Visit	Total Value of 1970 Use
Washoe	1	23,986	$4.40	$ 105,538
	2	600,000	4.50	2,700,000
	3	430	2.50	1,075
	4	1,519,374	4.10	6,229,433
	5	410	4.90	2,009
	6	6,690,351	1.25	8,362,939
	7	547,975	1.70	931,558
	8	291,888	1.30	379,454
	9	28,300	1.50	42,450
	10	0	--	0
	11	39,750	4.65	184,838
Total		9,742,464		$18,939,294

Types of Sites

1 - All streams and rivers under 15 cfs average minimum flow (August-October).
2 - All streams and rivers 15 cfs or more average minimum flow (August-October).
3 - All lakes and reservoirs with less than 500 total visits in 1970.
4 - All lakes and reservoirs with 500 or more total visits in 1970.
5 - All surveyed springs.
6 - All city and county parks as of 1970.
7 - All state parks as of 1970.
8 - All other unclassified parks and campgrounds.
9 - All Forest Service and Bureau of Land Management campgrounds as of 1970.
10 - All other developed and undeveloped recreation areas with less than 500 total visits in 1970.
11 - All other developed and undeveloped recreation areas with 500 or more total visits in 1970.

Source (S-5)

TABLE 2-E

AVERAGES OF VARIOUS CATEGORIES OF COSTS
BY DISTANCE ZONES

Zone No.	Respondents	Depreciation Costs	Variable Costs	Travel Costs	Time Costs	All Costs	Money Spent In Area
			- Dollars -				
			WARRIOR POINT DAY USE				
1	0	--	--	--	--	--	--
2	132	4.91	2.22	3.07	5.01	13.92	2.28
3	8	1.05	3.27	8.92	12.12	22.57	2.76
4	7	14.79	3.97	4.22	4.76	26.24	4.83
5	7	.13	2.10	2.10	4.65	7.84	2.03
			WARRIOR POINT OVERNIGHT USE				
1	0	--	--	--	--	--	--
2	35	20.53	3.20	2.14	3.76	28.90	3.04
3	10	14.71	3.44	7.24	7.49	31.81	2.79
4	13	4.83	2.06	8.93	13.85	28.72	2.50
5	7	10.47	3.05	9.26	11.83	30.82	2.19

Source: (S-5)

Principal outdoor recreation facilities are shown on the WCOG maps of the unincorporated portion of Washoe County (Lake Tahoe to Pyramid Lake) and Cities of Reno and Sparks which are included in the open space plan for Reno-Sparks and Washoe County (P-3). This plan recommends standards for development of specific recreation facilities to meet public needs.

In addition to outstanding natural recreational resources, the study area is well known for its gaming casinos and night life. The casino doors are always open and the action goes on day and night. These casinos offer every type of gaming excitement. Extraordinary entertainment is found in the area's showrooms. Big name performers are attracted from the world of entertainment complemented by a variety of smaller shows. The area boasts many superb restaurants with reputations for dining excellence.

Climate

The climate of the Truckee River Basin can be defined by assessing long term weather patterns, including temperature, precipitation, wind, sunshine and sky cover. Since climate can significantly affect water supplies, air quality and development suitability, it should be considered when designing wastewater treatment facilities.

Elevations in Washoe County range from 3,460 feet at Pyramid Lake to 10,800 feet at Mount Rose (W-1). Reno/Sparks is located at an elevation of 4,400 feet, at the bottom of a "bowl" 10 miles wide and 16 miles long. The walls of the bowl rise approximately 250 feet above the bottom on all sides (B-1). This situation profoundly affects the area's precipitation, temperature and wind patterns (E-2).

Precipitation is minimal (5 inches or less) on the floor of the bowl and in regions east of Reno. It increases proportionately with increased elevation along slopes to the west and, at higher elevations, generally occurs as snow. Precipitation to the north and south of Reno is governed by this east-west rainfall intensity pattern. Variations in temperature and precipitation with elevation for several stations in the Reno area are presented in Table 2-F. Average monthly and annual precipitation rates in Reno are presented in Tables 2-G and 2-H. Average annual frequency of both rain and snow storms is shown in Table 2-I.

TABLE 2-F

SELECTED CLIMATIC DATA

Station	Elevation (feet)	Mean Annual Temperature (°F.)	Frost-free Season (days)	Mean Annual Precipitation (inches)
Boca, CA	5,532	41.7	10	-
Bridgeport, CA	6,420	43.0	51	10.20
Carson City, NV	4,675	49.7	123	10.81
Donner Park, CA	5,937	-	-	37.55
Fallon, NV	3,965	50.9	150	4.81
Glenbrook, NV	6,400	47.1	118	17.27
Hawthorne, NV	4,186	55.1	135	4.58
Lahontan Dam, NV	4,158	54.0	159	4.21
Minden, NV	4,700	49.4	104	9.35
Reno, NV	4,411	49.4	129	7.20
Schurz, NV	4,124	52.3	112	5.31
Smith, NV	4,750	49.4	90	6.69
Susanville, CA	4,195	49.5	121	15.27
Tahoe City, CA	6,228	42.4	77	30.27
Truckee, CA	5,982	43.5	30	28.12
Yerington, NV	4,375	50.1	107	4.79

Source: (E-2)

TABLE 2-G

TEMPERATURE AND PRECIPITATION
NORMALS, MEANS, AND EXTREMES
RENO, NEVADA

Month	Temperature °F							Precipitation in Inches										
	Normal			Extremes				Water Equivalent							Snow, Ice Pellets			
	Daily Maximum	Daily Minimum	Monthly	Record High	Year	Record Low	Year	Normal	Maximum Monthly	Year	Minimum Monthly	Year	Maximum in 24 Hrs.	Year	Maximum Monthly	Year	Maximum in 24 Hrs.	Year
(a)				11		11			33		33		33		33		33	
J	45.4	18.3	31.9	70	1967	-11	1971	1.21	4.13	1969	T	1966	2.37	1943	20.0	1956	12.0	1956
F	51.1	23.0	37.1	74	1967	0	1968	0.86	3.69	1962	T	1967	1.55	1962	23.5	1969	13.9	1959
M	56.0	24.6	40.3	83	1966	0	1971	0.70	2.02	1952	0.03	1972	1.21	1943	29.0	1952	16.9	1952
A	64.0	29.6	46.8	88	1966	15	1970	0.47	2.04	1958	T	1962	1.64	1958	7.5	1958	7.3	1958
M	72.2	37.0	54.6	95	1970	18	1964	0.66	2.89	1963	T	1970	1.29	1963	14.1	1964	9.0	1962
J	80.4	42.5	61.5	100	1972	29	1974	0.40	1.31	1965	0.00	1959	0.79	1969	0.2	1970	0.2	1970
J	91.1	47.4	69.3	103	1972	33	1974	0.26	1.06	1971	0.00	1951	0.80	1949	0.0		0.0	
A	89.0	44.8	66.9	103	1972	29	1968	0.22	1.65	1965	0.00	1957	0.97	1965	0.0		0.0	
S	81.8	38.6	60.2	96	1971	20	1965	0.23	1.02	1950	0.00	1971	0.80	1971	T	1971	T	1971
O	70.0	30.5	50.3	91	1965	8	1971	0.42	2.14	1945	T	1966	1.55	1962	5.1	1971	3.7	1971
N	56.3	23.9	40.1	76	1969	8	1964	0.68	2.04	1946	0.00	1959	1.23	1949	8.7	1961	6.7	1961
D	46.4	19.6	33.0	70	1969	-16	1972	1.09	5.25	1955	0.01	1947	2.16	1955	25.6	1971	14.9	1971
YR	67.0	31.7	49.4	103	AUG 1972	-16	DEC 1972	7.20	5.25	DEC 1955	0.00	SEP 1974	2.37	JAN 1943	29.0	MAR 1952	16.9	MAR 1952

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 106 in July 1931; lowest temperature -19 in January 1890; maximum monthly precipitation 6.76 in January 1916; maximum precipitation in 24 hours 2.71 in January 1903; maximum monthly snowfall 65.7 in January 1916; maximum snowfall in 24 hours 22.5 in January 1916.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.

T Trace

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.

Source: (C-22)

TABLE 2-H

ADDITIONAL CLIMATIC DATA:
NORMALS, MEANS, AND EXTREMES
RENO, NEVADA

Month	Relative Humidity Percent				Wind					Percent of Possible Sunshine	Mean Sky Cover, Tenths, Sunrise to Sunset	Mean Number of Days										
							Fastest Mile					Sunrise							Temperature °F Max.		Temperature °F Min.	
	Hour 04 (Local Time)	Hour 10 (Local Time)	Hour 16 (Local Time)	Hour 22 (Local Time)	Mean Speed m.p.h.	Prevailing Direction	Speed m.p.h.	Direction	Year			Clear	Partly Cloudy	Cloudy	Precipitation .01 Inch or More	Snow, Ice Pellets 1.0 Inch or More	Thunderstorms	Heavy Fog, Visibility 1/4 Mile or Less	90° and Above	32° and Below	32° and Below	0° and Below
(a)	11	11	11	11	32	15	15		32	32	32	32	32	32	32	32	32	32	11	11	11	11
J	73	66	51	69	6.0	S	80	SW	1968	66	6.2	9	7	15	6	2	0	2	0	4	27	2
F	70	56	37	60	6.1	S	60	SW	1974	68	6.1	8	7	13	5	2	*	1	0	*	25	*
M	66	45	31	53	7.5	WNW	80	SW	1968	74	5.8	9	9	13	6	2	*	*	0	*	26	*
A	64	37	27	48	8.0	WNW	48	SE	1972	80	5.5	9	10	11	4	1	*	*	0	0	22	0
M	65	33	25	44	7.6	WNW	48	SW	1973	80	4.9	12	10	9	5	*	2	*	1	0	7	0
J	69	34	24	43	7.2	WNW	46	NW	1974	84	3.6	17	7	6	3	0	2	0	7	0	1	0
J	67	29	19	38	6.5	WNW	44	SW	1962	92	2.1	23	6	2	3	0	4	*	22	0	0	0
A	69	31	20	40	6.2	WNW	43	SW	1968	93	2.1	23	6	2	2	0	3	*	19	0	*	0
S	70	33	21	46	5.5	WNW	42	W	1970	92	2.3	22	5	3	2	0	1	*	4	0	7	0
O	72	41	27	56	5.3	WNW	50	S	1962	83	4.0	16	7	8	3	*	1	*	*	0	21	0
N	73	58	43	66	5.2	S	52	SW	1967	70	5.7	10	7	13	5	1	0	1	0	*	23	0
D	74	66	54	70	5.1	SW	68	SW	1968	63	6.4	8	7	16	6	2	0	3	0	5	28	2
YR	69	44	32	53	6.3	WNW	80	SW	MAR 1968	80	4.5	166	88	111	49	9	13	8	54	10	188	3

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
* Less than one half.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Source: (C-22)

As indicated in these tables, rainfall averages 7.20 in/yr at Reno, while snowfall averages 26.1 in/yr. Most of this occurs during the period from December through March. At least 1 inch of snow or ice falls an average of 9 days each year (C-22). The average rainfall event is 0.18 inches and the average duration is 6.35 hours (W-1). The increase in precipitation at higher elevations to the west of Reno is demonstrated by the annual precipitation figure (28.12 in/yr) at Truckee, California, 20 miles to the west at an elevation of 5,982 feet. During the summer, Reno's water supplies are almost completely dependent on precipitation in these mountains to the west and the transport of this precipitation to Pyramid Lake via the Truckee River system.

TABLE 2-I

ANNUAL AVERAGE FREQUENCY OF VARIOUS-SIZED STORMS AT RENO, NEVADA

Storm Size	Occurrences Per Year
At least 0.01 in.	43
At least 0.05 in.	37
At least 0.10 in.	24
At least 0.50 in.	4
At least 1.00 in.	1

Source: (W-1)

Although temperatures are generally mild, the range between daily minimum and maximum temperatures is considerable, often exceeding 45°F. Temperatures during the night are rarely greater than 60°F. Mid-winter afternoon temperatures are moderate (45°F) and temperatures fail to rise above freezing only about 10 days a year (C-22). Average and extreme monthly and annual temperature data are shown in Table 2-G.

Winds at Reno are extremely variable. The prevailing, large-scale circulation of the atmosphere generally causes a flow of air down the slopes of the Sierra Nevada Mountains toward Reno (B-1), and light to moderate winds from the west or southwest predominate (C-22). At times, up-slope winds may replace down-slope winds as a result of heat transfer due

to differential warming or cooling at different elevations. During the winter months when mountain slopes are covered with snow, which is highly reflective, very little heat transfer can occur and the Reno area generally experiences calm winds, especially during the night (B-1). Wind speeds of up to 80 mph have been recorded when storms occur in the mountains during winter (C-22).

Additional climatological features of the Reno area include its low humidity and high incidence of sunshine, especially during the summer months. During August, sunshine occurs an average of 29 days out of 31 and afternoon humidities average 21 percent (C-22). These characteristics combine to produce an extremely high evaporation rate which affects the water supply and causes the summer climate of Reno to be quite arid (D-2).

Significant effects of climate on the Reno-Sparks area can be summarized as follows:

1) High summertime temperatures, low humidities, and high evaporation rates combined with low annual precipitation rates severely limit the amount of water available within the Truckee River Basin, and intensify the importance of the Truckee River as a water source.

2) Frequent low wind speeds and inversions combined with the scarcity of rainfall make the area susceptible to accumulation of air pollution during the winter months.

3) The relatively short growing season, the lack of precipitation during summer months, the high evaporation rate, and the high cost of irrigation make the land surrounding Reno-Sparks generally unsuitable for agriculture without irrigation. Strong winds accompanying the passage of storms often damage the plants.

4) The lack of inexpensive, abundant water has deterred heavy industry requiring this natural resource from locating in the Reno-Sparks area.

HISTORIC AND ARCHAEOLOGICAL RESOURCES (E-2)

Introduction

The historic and archaeologic resources in the project area are uniquely inter-related. This situation exists because the Truckee River has never been systematically surveyed by archaeologists. The Washoe Territory, a 4,000 square mile area bisected by the Truckee River, was the original home of the Washoe* and Paiute Indian groups. The river itself is recognized as having been an important economic resource for these peoples. However, ethnographic references of the Washoe are not as lengthy or detailed as for many of the Great Basin tribal groups because the Washoe were displaced early in the historic period.

Early Indians

It is known that the Washoe were hunters and gatherers who pursued a semi-nomadic yearly collecting cycle. Through the course of the year they would move within the Washoe Territory to those areas which had the most abundant food sources depending upon the season. Generally they spent the more severe months in the lower elevations and moved on to the higher elevations in the spring and summer months. The Washoe generally spent fall in the Virginia and Pinenut Mountain ranges gathering pine nuts and other edible forms of vegetation. They moved on in winter to the low valleys, hunting on the east slopes of the Sierra Nevada. Often they would establish their winter villages around hot springs. When the spring arrived, they moved on, trekking through the Sierras and eventually arriving in the Lake Tahoe area to spend the later spring and summer months fishing and gathering nuts.

Fishing was a major activity for the Washoe, having both economic and social implications. In the Tahoe area, fishing camps were established along the streams draining into the Truckee River, rather than focusing on the river itself. These camps were the center of family activities during the fishing season. Five or six circular

---

*Washoe is the present-day spelling of the tribal name Washo, a nomenclature preferred by archaeologists.

windbreaks, known as gadu, were erected; each housed a family unit of between 7 and 13 people. Fortunately, many ethnographic sources describe fishing techniques and activities centered in the Tahoe area.

Each of the camps mentioned above had a bedrock mortar, called a lam, located near it which was used to grind seeds or other plant foods. The fishing activities themselves entailed many methods including the use of dams and weirs, netting, the techniques of trapping, taking by hand, and spearing from a blind platform. The Washoe's fishing techniques were best suited for small streams; in some instances, they even resorted to stream diversion to augment their fishing skills.

In addition to the Washoe, the Paiute, a member of a tribe of Uto-Aztecan Indians, also inhabited the region particularly along the Truckee from the Sierras to Pyramid Lake (H-23, H-24, N-7, W-12).

Trappers and Explorers

No record exists, but it is possible that trappers working the eastern slope of the Sierra Nevada mountains encountered the Truckee River and its tributaries as early as 1832. The first formal mention of the river is found in the journals of Captain John C. Fremont who crossed it on Januray 16, 1844. This crossing took place near the present town of Wadsworth where Fremont gave the river the name "Salmon Trout". Previously Fremont had discovered Pyramid Lake, and later he was to come upon Lake Tahoe; but he never perceived that the three geographic features were part of a single lake-river system.

The present name of the Truckee River was probably first applied in 1844 or 1845 when the Truckee Canyon became a part of the Overland Trail. In May of 1844, Caleb Greenwood left Missouri leading a party of California-bound immigrants. By early fall, this group had arrived at the Humboldt Sink where Greenwood and Elisha Stevens, another member of the party, met an aged Indian by the name of Truckee. Truckee claimed that they could reach California by following a local river upstream. Shortly thereafter Stevens, Martin Murphy and Greenwood followed the course of the river to determine if what the Indian had said was correct. They were elated to discover that the river would indeed carry them on to California and gave the river the name of their Indian guide.

This expedition, the Stevens-Murphy party, firmly established a new route to California. Subsequently, thousands of immigrant parties, including the tragic Donner party, followed this

route through the Sierras to California. The discovery of gold in California in 1848 increased the popularity of the Truckee River route. With the discovery of the Comstock Load in Nevada in 1859, traffic over the route became two-way. In the course of this increasing activity, several trading stations and inns were established in the Truckee Meadows area and in the Truckee Canyon. At least two toll bridges were also constructed, one at Hunter's Station built in 1860 and the other at O'Neil's Station, which was constructed in 1854. The most important of the trading stations and inns were Jammison's Station and Glendale, both east of Reno, Junction House located on the site of the Golden Road Motel, Hunter's Station located at the site of the Mayberry Crossing, and O'Neil's Station.

Coming of the Railroads

The United States Government had become increasingly interested in a transcontinental railroad by the mid-1850's, and five routes were surveyed across the American West. None of the proposed crossings involved the Truckee Canyon route, although three of the proposed routes crossed Nevada. At this point, Theodore Judah, a tireless promoter of the transcontinental railroad, proposed that a route be surveyed involving the Truckee Canyon. Judah then carried out the initial survey of the area in the early 1860's. Under Judah's continuing urging, the Truckee Canyon route was finally selected. Later, in October 1863, grading and tracking operations began in Sacramento and moved eastward. It took until late 1866 for grading operations to reach the Truckee Canyon area, and by December 13, 1867, the tracking crew reached the California-Nevada boundary. By May 4, 1868, the future site of Reno had been reached.

Early development of the Reno area was closely tied to the railroad. Although cattle and sheep ranching, dairy farming and the production of forage crops has been carried on in the Truckee Meadows for over a century, it was the coming of the railroad which created the first urban scene. In 1868, Myron Lake offered the Central Pacific Railroad a piece of land for a depot. This tract was located on the north side of the Truckee River and roughly centered in Truckee Meadows. The tract was surveyed, and on May 9, 1868, lots were auctioned off to men who had been camping in the nearby vicinity. Over 100 homes and businesses had been erected on this land within 2 weeks of the auction. Two years later the population of the area had increased to over 1000. Although numerous names for the new community were proposed, Charles Crocker, construction superintendent for the Central Pacific Railroad, championed the name "Reno" in honor of General Jesse Reno, a Union officer killed during the Civil War, and it was this name which appeared on the original survey map filed in August, 1868. In 1871, Reno was named the County Seat of Washoe County.

Reno's potential as a supply and railroading center grew when the Virginia and Truckee Railroad was completed from Carson City on August 24, 1872. Lumbering operations in the Truckee Canyon and the Sierras to the west together with the opening of the Nevada, California and Oregon Railroad in the early 1880's made Reno a supply point for a vast area to the north and west in California and Oregon. In 1904 the Southern Pacific Railroad moved its terminal and repair facilities from Wadsworth to an area east of Reno which became the City of Sparks. New mineral discoveries in Tonopah and Goldfield expanded Reno's railroad and supply business since the Southern Pacific reached the mining camps via the former Carson and Colorado Railroad. Reno soon became the headquarters for mining and financial concerns associated with gold and silver strikes in central Nevada.

Within 20 years of the establishment of Reno, the Truckee Canyon area had become a site of resorts and, subsequently, hydroelectric facilities. In 1888, Sumner Lee "Sam" Laughton had established Lawtons Hotsprings. This resort on a 420 acre ranch, included seven bath houses and a large walled-up mineral spring. It became one of the most famous resorts in northern Nevada. Eleven years later, in 1899, a hydroelectric plant was established at Farad. This was followed by the Washoe Station at Mogul in 1902, the plant at Fleisch in 1904, and the Verdi plant in 1909. All of these facilities were operated by the Truckee General Electric Company, predecessor of the current Sierra Pacific Power Company.

Judah's selection of Truckee Canyon as the railroad route had continuing important implications for the Reno-Sparks area. America's first transcontinental auto route, the Lincoln Highway, passed through the Truckee Canyon area. It was completed in June of 1927. U.S. Highway 40 also followed this basic route as does the latest transcontinental auto route, Interstate 80.

Legalized Gaming and Urban Development

During the Depression, the Reno-Sparks economy was significantly aided by the legalization of gaming in Nevada and the enactment of the 6-week divorce law. The City of Reno proceeded cautiously, however, in issuing licenses and gaming did not expand significantly until World War II and the post-war decades. Gaming and big-name entertainment continued to be the area's main attraction, but skiing in the nearby Sierras began to assume considerable economic importance. Within the last 10 years, development of substantial warehousing resulted from Nevada's freeport laws and Reno-Sparks central location in the western states.

Reno has an elegant theatre-auditorium, a convention center, a beautiful county library and numerous other cultural and educational features. The University of Nevada, after its transfer from Elko to Reno in 1885, has evolved into a complex and sophisticated educational institution. Reno is also the home of the Western Nevada Community College.

During both the 1950's and 1960's, the Reno-Sparks area doubled in population. Housing developments and large suburban shopping centers today occupy much of what was once farm and agricultural land. These developments have drawn shoppers from the traditional downtown commercial center and there has also been an expansion of casino operations away from the central section. This rapid development has had historic and archaeologic as well as economic impact. The Truckee River itself, and much of Reno-Sparks vicinity, has not undergone organized archaeologic investigation before physical improvements obliterated many of the sites which are thought to have existed. Consequently, literature search does not suffice for archaeologic investigation in the field and led to the study process next described as a part of the environmental investigations of the facilities plans.

Archaeologic Methodology

The first step in the archaeologic investigation concerning the proposed project was an archival search; this effort revealed that little archaeologic work has been done in the Reno-Sparks area and few tests of the ethnographic reports have been made. A catalog of known archaeologic sites was constructed principally from two professional studies, one by Elston and another by d'Azevedo. This material, combined with information supplied by avocational archaeologists, notably Gladys Smith, formed the basis for the subsequent field reconnaissance.

Most of the known archaeologic sites, identified through the process outlined above, occur in areas which have been developed. Thus the sites themselves have been destroyed and there was never an opportunity to study them. Therefore, the remaining sites are especially significant not only because of the information preserved in them, but also because they may offer the last opportunity for archaeological research concerning the Reno-Sparks area.

Since the proposed projects are still in the planning stage, the scope of field studies was preliminary rather than intensive. They were not sufficient in scope to locate, evaluate or test every archaeologic site within the project area or along the proposed alternate alignments. An attempt was made to locate the

major archaeological resources; sites potentially eligible for the National Register, or resources which might require extensive protection measures affecting future planning decisions and/or construction costs.

Under the auspices of the University of Nevada, and through an agreement with the Nevada State Museum, a number of field surveys were conducted on the various locations in the study area which might be affected by construction. The Nevada Archaeological Survey conducted this field reconnaissance activity; work was performed by Robert Elston, Cameron Covington, Alan Leethal, and Gail Townsend. Philip Earl, of the Nevada Historical Society, also investigated the area from Dickerson Road up the Truckee River to Verdi.

The process for these investigations involved the following steps: the accessible sections of the alternate routes were examined visually. Attempts were made to examine an area 100 to 200 feet wide. This is not considered to be an intensive examination of the ground and is not sufficient to locate all archaeologic resources. However, this method is sufficient to locate any large sites, a site that would require changing alignment, or which would require additional costs to the project. Access to certain sites was also a problem. Areas along the Truckee River were not examined if the property was fenced and clearly posted against trespassing. Dense vegetation and pasture made it difficult, if not impossible, to locate archaeological sites from the evidence of stone tools or other artifacts lying on the surface. When archaeological sites were found they were mapped and recorded, but no collections were made nor were the sites tested.

A substantial amount of archaeological material was discovered in the course of this field reconnaissance. Eight sites were found during the field study along the Verdi-Lawton Interceptor route. Only the sites along the river route, however, will be affected. Of these eight sites, four had previously been identifed by Elston (E-2). These sites are discussed below.

Archaeologic Findings

- Verdi-Lawton Interceptor Route

  Site locations are plotted on maps and are available to persons evaluating this project. An archaeologic site map is not submitted with this report to preclude possible destruction of those sites by the public.

Site 26 Wa 2155: This site is located between the railroad tracks and the Truckee River, west of Reno. A large area approximately 1/4 mile in length is covered with waste material from the manufacture of stone tools. The material is primarily sinter, a silicate deposit probably quarried at Steamboat Hot Springs.

This site is potentially eligible for nomination to the National Register of Historic Places. It is the only known site in the Reno area adjacent to the Truckee River that has escaped destruction. The probability of buried archaeological components is high; sinter waste flakes appear to be eroding out of the site. Neitner the site nor its context will be affected by construction. The Railroad Alternate is north of the railroad tracks and the site. The River Alternate in this section will be on the opposite side of the river. No further work would be necessary unless alignments were changed (E-2).

Site 26 Wa 2156: Several boulder metates were found near the Truckee River. No waste flakes or other stone tools were found associated with this site. The area will be crossed by the River Alternate and further testing would be necessary to evaluate this site if the River Alternate is selected (E-2).

Site 26 Wa 2157: This is a basalt boulder petroglyph site located on a terrace remnant of the Truckee River. It will not be affected by either the Railroad or River Alternate. A few widely scattered chert and basalt flakes were found near the boulder. There is little evidence that the area was used more intensively.

To the west, between the terrace and the Truckee, land is used for pasture. Several houses have been built north of the site. On the south and east highways, the railroad, a borrow pit and irrigation canal have been constructed. No further damage to the context of the petroglyph will derive from construction of the interceptor (E-2).

Site 26 Wa 1407: This site located along the Truckee River is in Verdi described as a "bed-rock mortar and metate site located in a large boulder outcrop on the south bank of the river."

During the field survey a few waste flakes were found across the river from the boulders. The flakes are scattered thinly over a large area adjacent to and east of a small stream flowing in the Truckee. The River Alternate as now proposed will cross through the southern portion of the site. Further evaluation of the site and the possibility of altering the alignment should be included in planning if the River Alternate is chosen (E-2).

Sites 26 Wa 154, 26 Wa 1406, 26 Wa 1411: These three sites, previously reported by Smith and Elston, will not be affected by the alternates as they are now planned. The sites are located along the banks of a small stream flowing into the Truckee. The river routes will be constructed on the opposite side of the creek. Sites 26 Wa 154 and 1411 are both small task sites; 26 Wa 1406 is a petroglyph site located near 1411.

Site 26 Wa 68: This site was first studied by Heizer and Baumhoff (1962). A large boulder with a group of petroglyphs was located on the south side of the river about 200 yards from the bridge east of town. The petroglyph was moved during construction of the Viking Metallurgical Corporation and incorporated into their landscaping. This area has been pointed out by local residents as a historic Washoe camp area. During the survey a few remnants of this site were found although clearly displaced from their original context by construction. On the north bank of the river, adjacent to a stream are a few scattered flakes which may also be a part of this site. The flakes are thinly scattered in an area used for pasture. The western edge of this flake scatter will be crossed by the River Alternate. Further evaluation of the site and consideration of moving the alignment will be necessary.

- Cross-Town Interceptor Route

The archive search reported approximately 10 potential archaeological sites in the City of Reno near the proposed route. "These sites were completely destroyed early in the development of Reno" (E-2). Buildings, private property, paved roads and other construction is so extensive over these urban areas that no surface archaeology could exist (E-2).

- Spanish Springs Valley Disposal Site and Pipeline

This project component is proposed to be located in Spanish Springs Valley Section 36, T21N, R20E and was the subject of an archaeological reconnaissance. Following this reconnaissance, two other sections (Section 1 T20N, R20E and Section 6 or 7 in T20N, R21E) have also been proposed for consideration. An archaeological study of these alternates has not been conducted.

Within Section 36 and along the proposed transmission line, a large number of archaeological sites were discovered. Thirty-seven such archaeological sites were discovered in Section 36 alone. The majority of these sites were marked only by a small number (one to ten or so) of artifacts and probably represent a single task performed by a single individual. However, three sites were discovered in Section 36 which are larger, consisting of a scatter of artifacts over an area of between 1 and 3,000 square meters. These sites probably are camps or task sites which were visited several times and they may contain buried material. All of the sites in Section 36 seem to have been associated with hunting and repair of tools associated with hunting. Not a single tool processing plant was found in the entire square mile.

An additional 30 sites were discovered along the proposed pipeline route. All of these sites are located in Spanish Springs Valley. Houses, yards, paved roads and other construction is so extensive over the remainder of the proposed route that no surface archaeology could exist.

As in Section 36, most of the sites on the pipeline route contained one to a few artifacts. However, the larger sites are much more extensive than those in Section 36. The pipeline route parallels Spanish Springs Road, which in turn runs along the edge of a marsh at the southern end of Spanish Springs Valley. This must have been a productive environment and favored location in the past because there is a nearly continuous scatter of artifacts between the road and the marsh for at least 2 miles in Sections 22, 15, 14, 11, and 12. Such a concentration of material suggests a major winter village site but the 300 or so grinding stones observed indicates that seed processing was also an important activity here. It appears that most or all of these sites can be avoided by the

pipeline if it is placed along the east side of road beneath the existing roadway or drainage ditch, in which case no further testing is recommended.

The three largest sites in Section 36 should be systematically collected and tested for subsurface components.

- Treatment Plant Site

The existing treatment plant and proposed expansion are located on a pad which was cut out of the hillside. Because of this previous grading it is unlikely that any surface archaeology could exist.

SOILS AND GEOLOGY

Regional Setting: Geology and Seismicity

The geology of the region surrounding Reno is complex and consists of igneous, metamorphic, and sedimentary rocks ranging in age from Triassic to Recent. The regional geologic map, Figure 2-3, lists the geologic formations and their respective ages. Mesozoic rocks consist of metasedimentary and metavolcanic rocks which are intruded by granitic plutons. The metamorphic rocks have been informally divided into two units, the Peavine sequence exposed in the area southwest of Pyramid Lake and the Nightingale sequence exposed to the north and east of Pyramid Lake. Tertiary rocks of the Hartford Assemblage in southern Washoe and Storey Counties consist of complex volcanic flows with interbeds of pyroclastics plus occasional intrusives. Rocks of this assemblage range in age from Oligocene to Pleistocene and consist of several thousand feet of volcanics with occasional intercalated lenses of sediments. Deposits of Quaternary age consist of alluvial and lacustrine sediments. Volcanic rocks of Pleistocene Age are also present.

The geologic structure of the area is complex. There have been two main deformational episodes, one during the late Mesozoic era and the other during the Cenozoic era. Both episodes were accompanied by intense folding, faulting and low grade metamorphism. Numerous granitic rocks were intruded into the bedrock during Cretaceous and Miocene time. Cenozoic deformation began in the Miocene epoch and has continued to the present. Normal faulting, tilting, warping, wrench faulting, folding, and volcanism are evidence of this deformation.

PYRAMID LAKE
RENO
LAKE TAHOE
WASHOE LAKE
0 5 10 15 20 MILES

LEGEND

Q	Quaternary sediments - valley alluvium, glacial deposits, lake deposits, alluvial fan deposits
QTg	Pre-Lake Lahontan deposits - terrace, alluvial fan and pediment gravels
Qba	Pleistocene volcanics
T	Tertiary bedrock - Hartford Assemblage and Canyon Assemblage; sedimentary and igneous rocks
K	Cretaceous intrusive rocks
TrJ	Triassic and Jurassic metamorphic rocks - Peavine and Nightingale Sequences

Note: Faults have been omitted for purposes of clarity

Reference: Geology and Mineral Deposits of Washoe and Storey Counties, Nevada, Nevada Bureau of Mines, Bulletin 70, 1969

REGIONAL GEOLOGIC MAP
PROJECT SERVICE AREA

FIGURE 2-3

Most of the region is seismically active. The eastern part of the Sierra Nevada Range contains several active faults capable of generating earthquakes. Many active and possibly active faults have been located in the region, particularly in the Reno area and to the south. According to the historic record, many earthquakes have been centered within the region with magnitudes ranging up to 7.0+ on the Richter Magnitude Scale. In general, the active faults in the region are discontinuous and relatively short. Since the magnitude of earthquakes is largely proportional to the length of the causative fault, the maximum expectable magnitude for the area is generally low to moderate. The earthquake epicenter map, Figure 2-4, shows the distribution of recorded epicenters.

Regional Setting: Soils and Minerals

Soils in the region are highly varied and are related to parent material, particle size, nutrient abundance, drainage characteristics and erodibility. Generally, soil development on bedrock is relatively minor because the generally arid climate is not favorable for deep chemical weathering. Soils in the alluviated valleys are predominantly granular and contain abundant sand, silt, and gravel. Several areas contain clay soil deposits, primarily where weathered bedrock or older alluvium is present. The Soil Conservation Service of the United States Department of Agriculture has classified hundreds of soil groups in the region, most on the basis of terrain, use, and parent material. A description of the soil groups in the project service area can be found in Table 2-J.

Metallic and industrial mineral deposits are common in Washoe County. Mining activity has greatly decreased during the past several years but several industrial mineral operations are active. Important mining districts in the area are:

- Peavine District

  Located north of Verdi, this district has produced gold, silver, lead, and copper. Most of the mineralization occurs in highly altered bedrock which is bleached near the surface from downward percolation of sulphuric acid solutions derived from oxidation in the zone of weathering.

- Wedekind District

  This district is located north of the Reno-Sparks area and is an eastern extension of the Peavine District. The district is no longer active and much of the area is residentially developed. The principal mineral commodities

Preceding page blank

MAGNITUDE SCALE

1854-1931

- 7.0+
- 6.0-6.9
- 5.0-5.9
- 4.0-4.9

1932-1960

- 7.0+
- 6.0-6.9
- 5.0-5.9
- 4.0-4.9
- Low Magnitude, felt

FIGURES ADJACENT TO CIRCLES INDICATE THE NUMBER OF EVENTS THAT OCCURRED AT THOSE LOCATIONS.

MAGNITUDE IS EQUAL TO THE LOG a/a_0
a = MAXIMUM AMPLITUDE RECORDED BY A WOOD-ANDERSON SEISMOGRAPH 100 KM FROM EPICENTER

a_0 = AMPLITUDE OF ONE THOUSANDTH OF ONE MILLIMETER

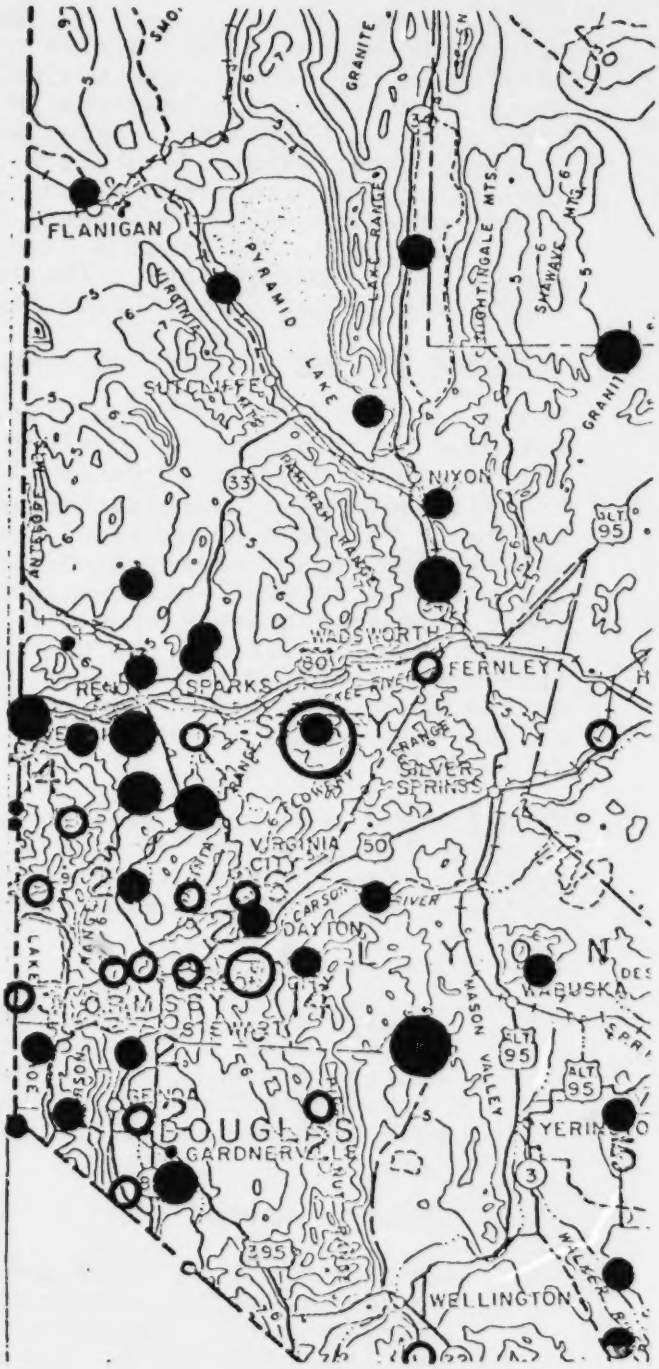


Figure 2-4

EARTHQUAKE EPICENTER MAP (RICHTER SCALE)

TABLE 2-J

SOIL UNITS

Map Unit Symbol (Plate 5)	Physiography	Slope	Soil Type	Drainage	Permeability	Erosion Hazard	Shrink-Swell Potential
Aridisols							
1A	Glacial outwash, flood plains	0 - 5%	clays, sandy silts, silty sands, gravels	poorly to well drained	moderate	low to moderate	low to moderate
1B	Alluvial fans	0 - 15%	clays, sandy clays	well drained	slow to moderate	moderate	high
1C	Pediments	5 - 15%	clays	well drained	slow	moderate	very high
1D	Mountain slopes	up to 70%	silts, clays, clayey gravels, silty gravels	well drained	slow to moderate	low to moderate	high to very high
Mollisols							
2A	River terraces, glacial outwash, flood plains, basins	0 - 5%	clays, silts, silty gravels, silty sands	poorly to well drained	slow to moderate	low to moderate	moderate to very high
2B	Pediments	0 - 15%	clays, clayey gravel, sandy clay	well drained	slow	moderate to moderately high	very high
2C	Mountain slopes	15 - 20%	silty sands, silty gravels, clays, silts, sand	well drained	slow to rapid	moderate to high	low to moderate
Entisols							
3A	Alluvial fans	0 - 15%	clays, silts, sandy silts	well drained	moderate	moderate	low to high
Landforms							
4A	Rock lands	5 - 50%	clays, clayey gravels	well drained	slow	moderate to high	low to very high

were silver and gold with some lead and zinc. Alteration and bleaching of the bedrock surface are present. The district is a possible geothermal area.

- Steamboat Springs District

  Located south of Truckee Meadows and contains various metallic minerals, mostly cinnabar, stibnite, gold and silver. The bedrock surface is highly bleached and altered. Cinnabar and sulfur have been mined by open-pit methods. This district contains steam wells and is a potential source of geothermal energy.

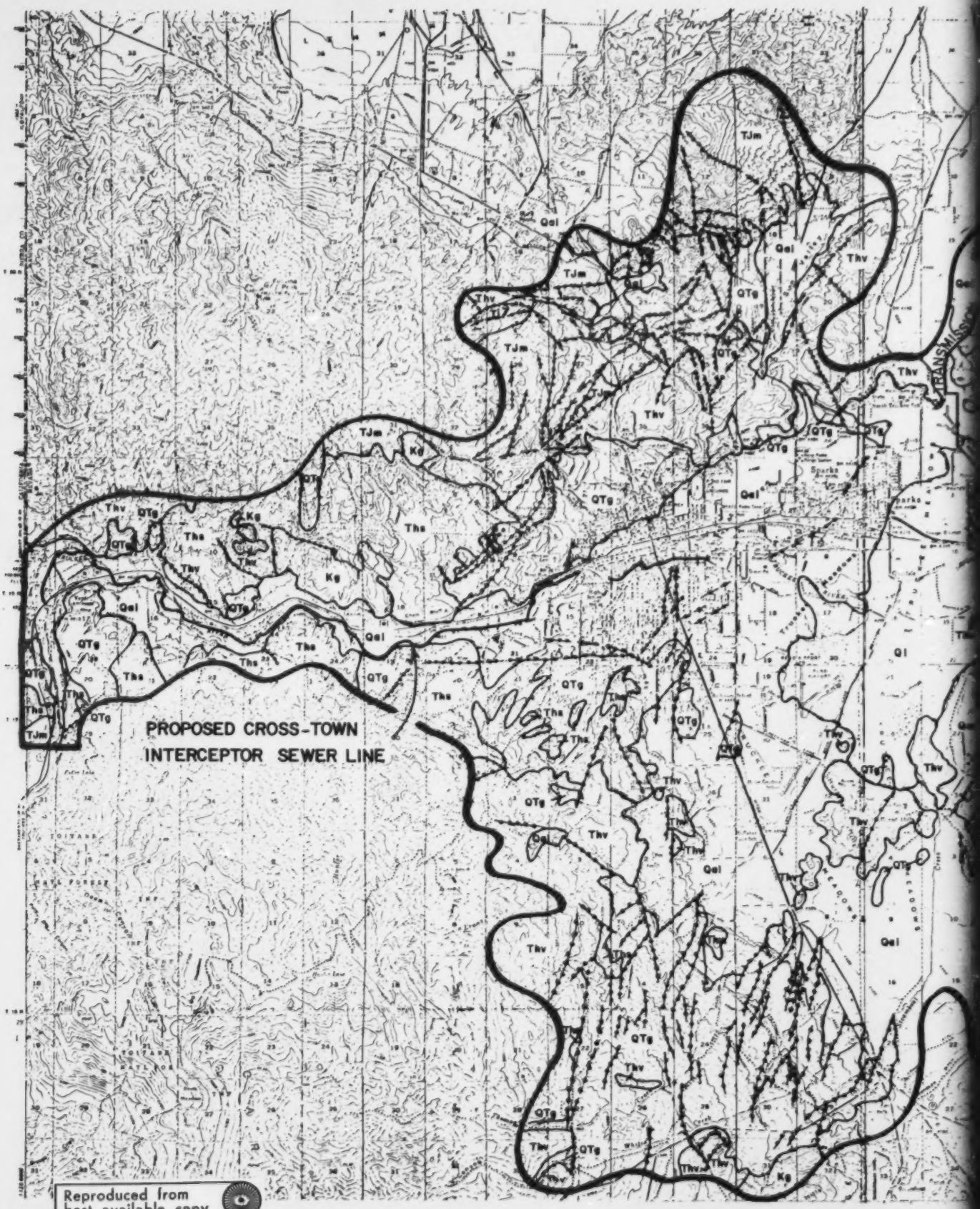
Industrial mineral deposits are present in the Reno area, and the annual tonnage value far exceeds that for metallic minerals mining. Sand and gravel is the largest single mining industry in the area. Pumiceous rhyolite is quarried in the south side of Truckee Meadows. Other commodities include clay deposits in the Steamboat Springs area, impure coal deposits northeast of Verdi, diatomite deposits along the Truckee River east of Reno and near Nixon, and several lightweight aggregate deposits in the Steamboat Springs area and the Truckee River area east of Reno. Most industrial mineral deposits are mined by open pit methods, several of which are being operated at the present time. Eagle-Picher Industries, Inc. mines diatomite from open pits and operates a processing plant near Clark Station on the lower Truckee River east of Reno.

Service Area Setting: Geologic Units and Faults

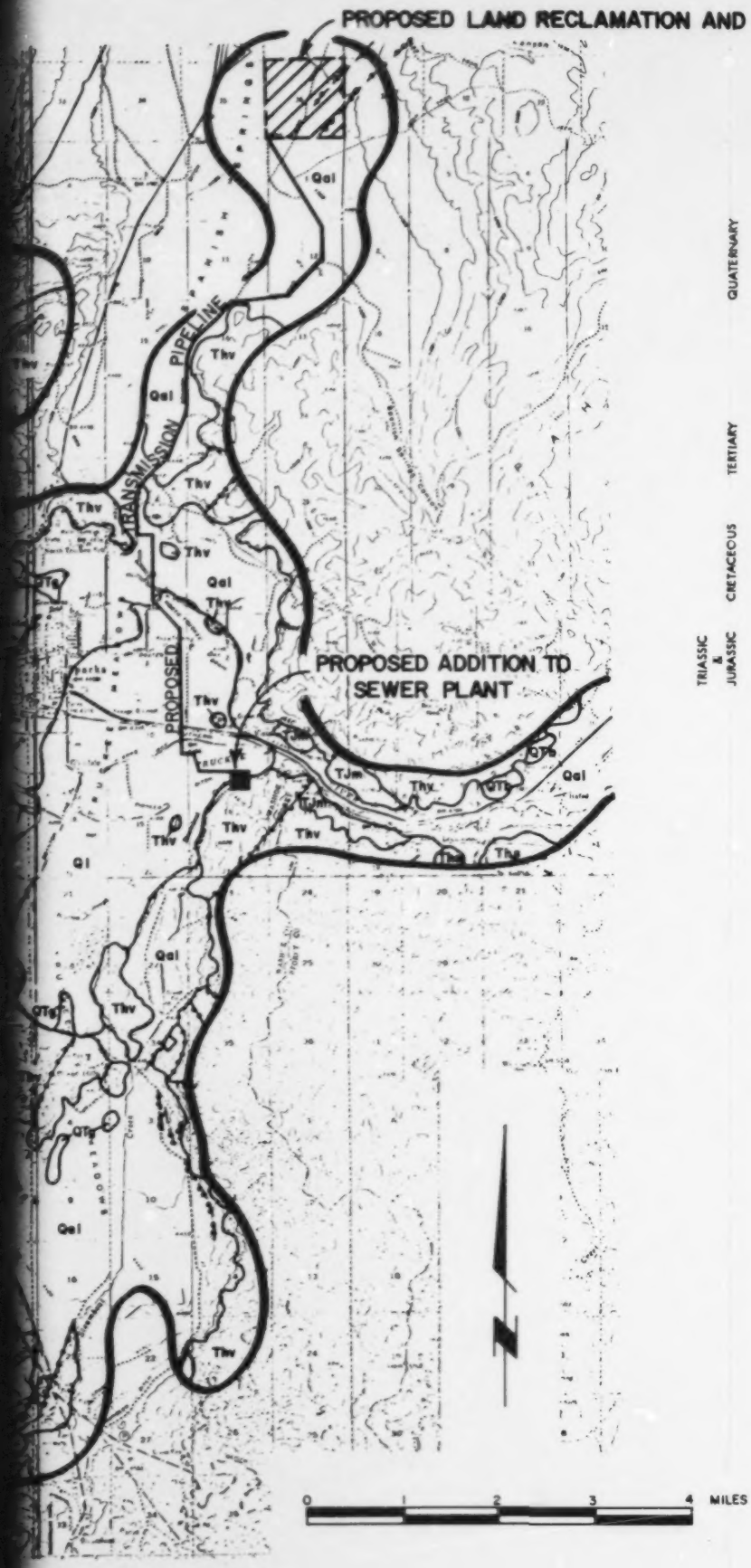
The area to be serviced by the proposed project encompasses most of the Reno area and surrounding vicinity. The area is outlined in Figure 2-5.

- Surficial Deposits

  Several alluvial deposits of Quaternary Age are present in the project area which have been grouped into one unit for purposes of simplification. The alluvium in the Reno area consists primarily of glacial outwash deposits of Pleistocene Age which have been reworked by the Truckee River. They consist of sands with gravels up to boulder sizes. Younger deposits of poorly sorted clay to silty gravelly sand are present along the margins of the outwash deposits and in the tributary valleys to the north and south. The alluvial deposits are believed to be over 1000 feet thick in the central and eastern part of the valley. The alluvium is unconsolidated and erodible.



Reproduced from best available copy.



EXPLANATION

Geologic Unit

QUATERNARY

Qal

Alluvium consisting of stream deposits

Ql

Lake deposits of clay, silt, sand and calcareous tufa

QTg

Pre-Lake Lahontan deposits of terrace, alluvial fan and pediment gravels

QTb

Basalt and andesite flows

TERTIARY

Thv

Hartford Assemblage consisting of volcanic flows and pyroclastics

Ti

Intrusive rhyolite

Ths

Hartford Assemblage consisting of sedimentary rocks

CRETACEOUS

Ka

Undifferentiated plutonic rocks ranging from gabbro to granite in composition

TRIASSIC & JURASSIC

TJm

Metamorphic rock consisting of metamorphosed sedimentary and volcanic rocks

SYMBOLS

Contact between geologic units

Fault, dashed where approximately located

GEOLOGIC MAP
PROJECT SERVICE AREA

FIGURE 2-5

Flood plain and lake deposits of Holocene Age are present in the eastern part of the Reno area and in the Truckee Meadows area. They generally consist of medium to thin bedded clayey silt and sand with occasional lenses of gravel and peat.

Alluvial fan deposits north of Reno consist of gravelly to sandy clayey silt. Sediment deposits northwest of Reno are included in this unit and consist of thin sheets of gravelly silt and silty clay. Some clay and silt deposits have a high shrink-swell potential and experience changes in volume with changes in water content.

- Bedrock Units

Volcanic rocks of the Hartford Assemblage are present in the service area. The Assemblage ranges from Oligocene to Pliocene in age and consists of highly variable volcanic rock types with occasional sedimentary interbeds. A detailed description is presented in the explanation on the regional geologic map, Figure 2-3. In most cases, the volcanic rocks are well consolidated and/or solidified; however, the pyroclastic and sedimentary interbeds (or sub-units) are only moderately consolidated. Metamorphosed sedimentary and volcanic rocks of the Peavine and Nightingale sequences of Triassic and Jurassic age are also present and are well consolidated and solidified. Occasional granitic intrusives are present in the area although their distribution is relatively small. Quaternary volcanics are also present.

- Faults

Many faults are present in the area as shown on Figure 2-6. Several fault traces have been identified in Quaternary Age sediments. Faults are considered active where they displace sediments 10,000 years old or younger. These faults may cause future earthquakes and surface displacement. According to the Nevada Bureau of Mines and Geology, an inferred active fault is located in the Sparks area, as shown on the geologic hazards map, Figure 2-6. Faults that displace deposits between 35,000 and 10,000 years old are considered possibly active. Several possibly active faults have been identified in the Reno area and in the vicinity of the proposed Cross-Town Interceptor Sewer line. Active and possibly active faults are also located in the project service area farther to the south between Reno and Steamboat Springs as shown on Figure 2-6.

Preceding page blank

Soils of the Service Area

The project service area contains many soil units. Each unit is based on physical characteristics which are highly variable throughout the area.* The following descriptions generalize the basic characteristics. The soil units are shown on the soil map, Figure 2-7.

- Aridisols

  This order consists of dry soils with low organic matter and slight to very strong weathering profiles. These soils occur on variable slopes ranging from basin lowlands to steep mountain slopes. They generally consist of silts and clays with abundant gravel. The soils are poorly to well drained and have a slow to moderate permeability. The erosion hazard is low to moderate. The clay soils have a moderate to very high shrink-swell potential.

- Mollisols

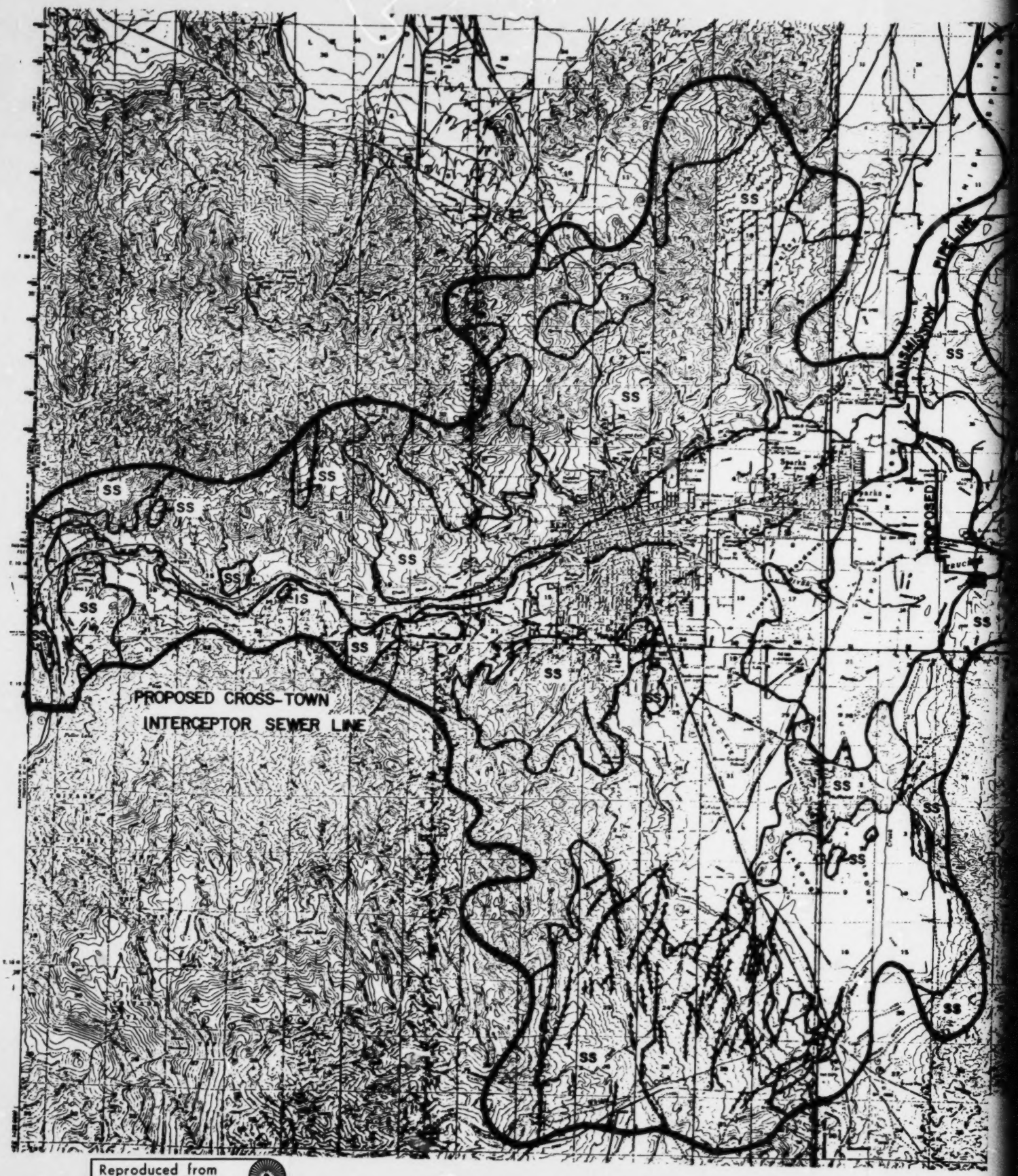
  This order consists of soils with dark surface horizons containing abundant organic matter. These soils are present on generally slight to moderately steep slopes. They consist of clay, sands, silts with occasional gravels. They are generally well drained and permeability is slow to rapid. The erosion hazard is low to moderately high and the clay soils have a moderate to very high shrink-swell potential.

- Entisols

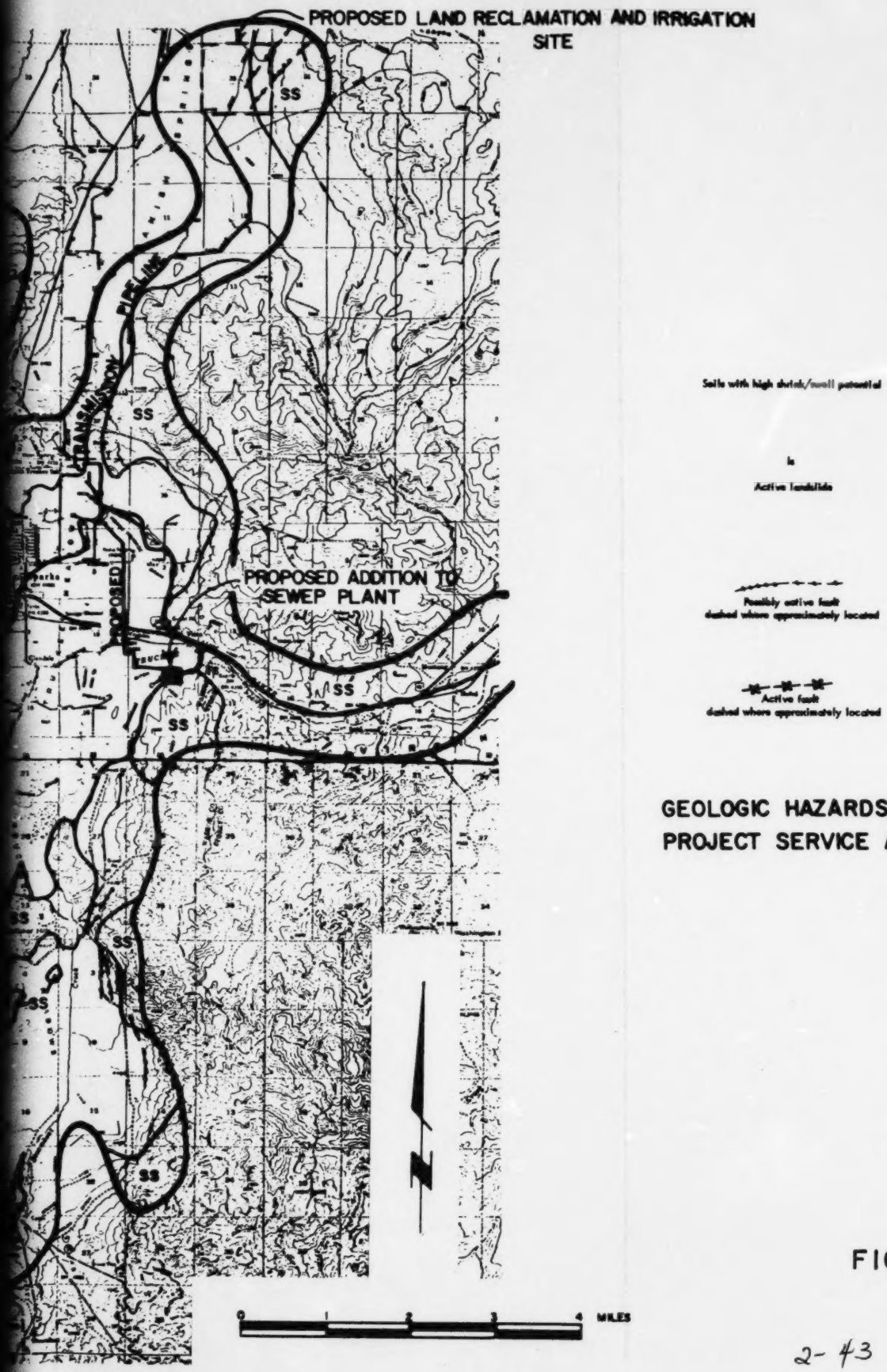
  This order consists of soils occupying geologically recent land surfaces having little evidence of physical or chemical alteration. They are generally present on slight slopes on alluvial fans and consist of clays and silts. The soils are well drained and moderately permeable. The erosion hazard is moderate and the soils have a low to high shrink-swell potential.

---

*Various soil maps at different scales were reviewed. Soil units from one map to another do not correspond and a generalized interpretation was necessary for describing the soil conditions and preparation of the soil map, Figure 2-7.

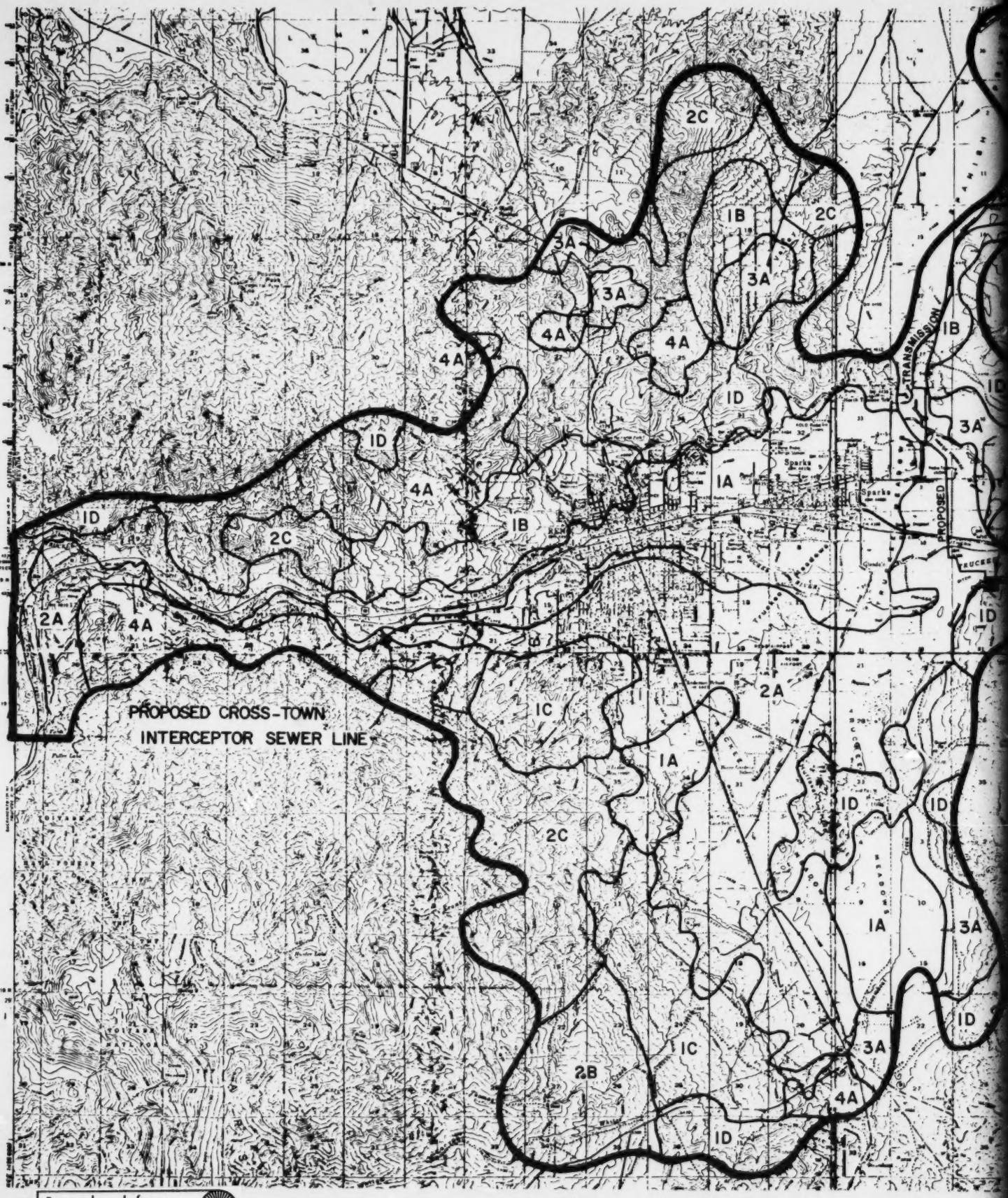


Reproduced from best available copy.

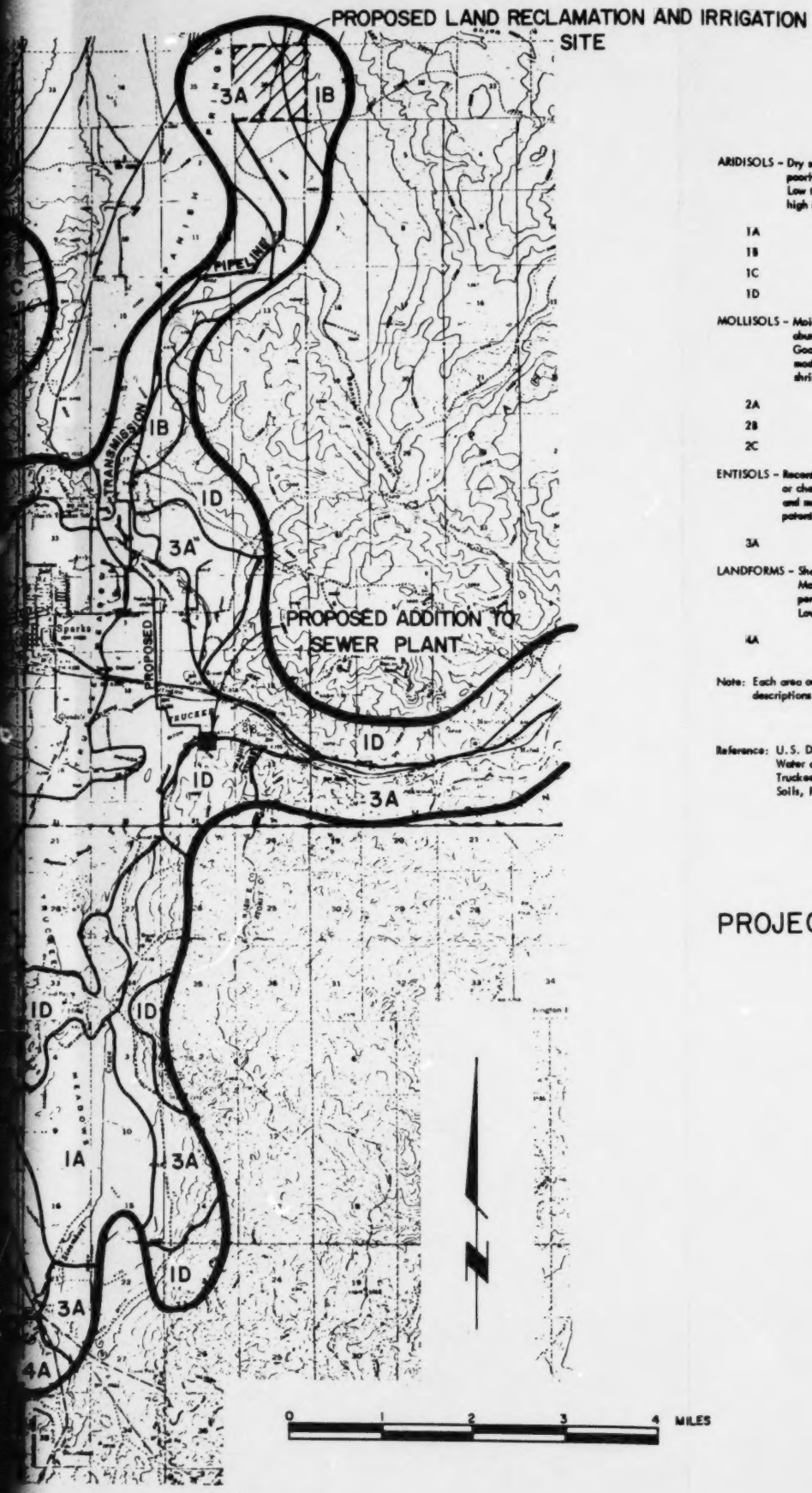


GEOLOGIC HAZARDS MAP
PROJECT SERVICE AREA

FIGURE 2-6



Reproduced from
best available copy.



EXPLANATION

ARIDISOLS - Dry soils with low organic content. Variable slopes, poorly to well drained. Slow to moderate permeability. Low to moderate erosion hazard. Moderate to very high shrink-swell potential.

1A
1B
1C
1D

MOLLISOLS - Moist or wet soils with dark surface horizons containing abundant organic matter. Slight to moderate slopes. Good drainage. Permeability slow to rapid. Low to moderate erosion hazard. Moderate to very high shrink-swell potential.

2A
2B
2C

ENTISOLS - Recent geologic land surfaces with little or no physical or chemical alteration. Slight slopes. Soils well drained and moderately permeable. Low to high shrink-swell potential.

3A

LANDFORMS - Shallow soils on weathered geological formations. Moderate to steep slopes. Well drained and slow permeability. Moderate to high erosion hazard. Low to very high shrink-swell potential.

4A

Note: Each area outlined has been generalized according to basic soil descriptions. Several kinds of soils are present in each group.

Reference: U.S. Department of Agriculture - Soil Conservation Service. Water and Related Land Resources, Central Lahontan Basin, Truckee River Subbasin, Nevada, California, Appendix 1, Soils, February 1970.

SOIL MAP
PROJECT SERVICE AREA

FIGURE 2-7

Preceding page blank

- Landforms

  This order consists of weathered geological formations with few separable soils. They are present on moderate to steep slopes containing bedrock and consist of clays with rock fragments. They are well drained and of slow permeability. The erosion hazard is moderate to high and the shrink-swell potential low to very high depending on the amount of clay present.

Geologic Hazards of the Service Area

Geologic hazards can be defined as those natural occurring events or conditions associated with the geologic environment which can adversely affect man-made projects and/or threaten life safety. The geologic hazards map, Figure 2-6, shows the geologic hazards for the area.

- Landslides

  Landslides are common occurrences where adverse conditions such as steep slopes, weak soils or rock, and high groundwater levels are present. Occasional landslides are present along the Truckee River; most are associated with alluvium or poorly consolidated sedimentary bedrock. Landslides have developed on slopes near Mogul, west of Reno, and are probably the result of slope oversteepening by river erosion. One active landslide is shown on the geologic hazards map, Figure 2-6; most slides are too small and infrequent to show on the map at the scale selected.

- Erosion Hazards

  Most of the surficial deposits in the service area are susceptible to erosion. In general, the alluvium contains abundant granular material which can erode rapidly if exposed to steep slopes and subjected to concentrated water flow.

- Expansive (Shrink-Swell) Soils

  Expansive soils are mostly highly plastic clays that undergo a significant volume increase with the addition of water. Clays of variable expansive qualities are present in many of the soils overlying both alluvial deposits and bedrock. Large areas of expansive soils are shown on Figure 2-7.

Preceding page blank

- Flooding

Flooding can be considered as a geologic hazard and is a potential problem in the Reno basin. An evaluation of flooding is not discussed in the soil and geologic section, but it is considered in Chapter 4 as a land use constraint.

- Fault Displacement

Many active faults are present in the region and those in the project service area are shown on Figure 2-6. These faults are judged as generally capable of experiencing surface displacement and generating earthquakes. An active fault may be present in the north Sparks area. Although this trace was inferred on the basis of 1941 aerial photo interpretation (E. C. Bingler, personal communication), it has not been definitely established by other criteria. Possible active faults are present in the service area as shown on Figure 2-6, and may also exist below the alluvium.

- Earthquake Shaking

Earthquake shaking is largely due to the release of seismic energy during periods of sudden displacement along the faults. The largest loss of life and property due to geologic hazards has been caused by violent ground shaking during earthquakes. In general, the intensity of ground shaking will depend on the distance to the earthquake epicenter, magnitude of the shock, and the dynamic response characteristics of the soil/rock. Intensity is presently measured by the Modified Mercalli Intensity Scale, presented in Table 2-K. The intensity of ground shaking can be amplified if saturated and deep alluvial deposits are present. Ground shaking is usually less intense where well consolidated bedrock is at or close to the surface. The effects of ground shaking are as follows:

1) Lurch Cracks - Surface cracks can develop in weak alluvial deposits, especially near banks of rivers, streams, and creeks. Lurch cracks may develop in the surface soils near the Truckee River, Steamboat Creek and the many drainage ditches in the area.

TABLE 2-Ka

MODIFIED - MERCALLI INTENSITY SCALE OF 1931

I Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced. Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.

II Felt indoors by a few people, especially on upper floors of multi-story buildings and by sensitive or nervous persons.
As in Grade 1, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.

III Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.
Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.

IV Felt indoors by many, outdoors by few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.
Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeable.

V Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.
Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.

VI Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.
Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows, break. Knick-knacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.

VII Frightens everyone. General alarm, and everyone runs outdoors.
People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.

VIII General fright, and alarm approaches panic.
Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack

TABLE 2-Kb

MODIFIED - MERCALLI INTENSITY SCALE OF 1931
(continued)

and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.

IX Panic is general.
Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings--some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.

X Panic is general.
Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations, are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.

XI Panic is general.
Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially neat shock centers, great to dams, dikes and embarkments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and come thrust endwise. Pipe lines buried in earth are put completely out of service.

XII Panic is general.
Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in form rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

2) Densification - These effects can occur where loose or soft soil deposits are present above the groundwater table. Such conditions may be present in low-lying areas including Truckee Meadows.

3) Liquefaction - This failure can occur in loose, cohesionless sandy soils with shallow groundwater levels. Soils which are variably graded and contain gravel and appreciable clay binder are generally not liquefiable. Most of the alluvial deposits in the service area have coarsely graded sands and gravels which are generally not susceptible to liquefaction; however, sand deposits which could liquefy may be present locally. The lake deposits in the Truckee Meadows area are potentially liquefiable since they are located in an area of high groundwater.

4) Landslides - Earthquakes can trigger or reactivate dormant landslides or cause new slides where weak soil/rock conditions are present. Flow slides due to liquefaction of sand lenses can occur on relatively flat slopes. Although sliding is a possibility along the Truckee River banks, it is not likely to be extensive.

Interceptor Routes: Soils and Geology

The Cross-Town and Lawton-Verdi Interceptors will be located adjacent to the Truckee River and extend from the town of Verdi to Reno, a distance of about 12 miles. Geology underlying the alternative routes consists of Quaternary Age stream and valley alluvium several hundred feet in depth. The alluvial deposits are glacial outwash materials with occasional large boulders. Although faults are not known to cross the route, two small possibly active faults are located south of the route in Reno. Groundwater along the route is relatively high.

Soil conditions in the western half of the route consist of clays, silts, clayey or silty gravels and clayey sand of the Mollisol group. The slopes are very gentle except for locally steep banks along the river. The soils are well drained and the soil profile is moderately permeable. The erosion potential for both water and wind is moderate. The shrink-swell potential is moderate. Soil conditions for the eastern half of the route consist of clays

and sandy silts (Aridisols) over sands and gravels. Slopes are gentle. Permeability is medium to high. The soils have a low shrink-swell potential and excellent drainage. Erosion hazard is moderate to high. Landslides are present on the slope south of the sewer line near Mogul. No landslide deposits are present underlying the route.

Treatment Plant Site: Soils and Geology

New structures will be located adjacent to the main existing building which is situated on colluvial soils and volcanic bedrock of the Hartford Assemblage. The new additions will probably be underlain by similar soils and rock. According to the USDA Soil Conservation Service, the Aridisol soils consist of stony clays and silts on steep slopes which are low to moderately erodible, and have high shrink-swell potential. The soils are well drained and have a slow permeability. Faults are not known to exist at the site and no landslide deposits are present. Groundwater is probably deep except just north of the site in the vicinity of Steamboat Creek which flows into the Truckee River. Compressible alluvial soils exist north of Steamboat Creek.

Spanish Springs Valley Disposal Site: Soils and Geology

This project component will be located in Spanish Springs Valley, in either Section 36, T21N, R20E, Section 1, T20N, R20E or Section 6 or 7 in T20N, R21E. The geology of the proposed site area consists of alluvial fan deposits several hundred feet in thickness overlying ancient lake beds and volcanic or sedimentary bedrock. The alluvium generally consists of unconsolidated sand, silt and gravel with abundant thin clay lenses. The lake beds consist of weakly cemented sands gravels and clays. Two possible small northeast trending faults are present in the alluvium in Section 36.

The soils consist of several feet of clay and sand topsoils over sand and gravel. Cemented hardpan is present in Sections 1 and 6. In general, the soils are well drained and have a moderate permeability; however, hardpan and the impervious clay lenses could inhibit percolation. The possible faults in Section 36 could be restrictive varients to water migration. The soils are low to moderately erodible and have low to high shrink-swell potential. Water well data for the area indicates water-bearing horizons between about 70 and 300 feet with yields at several hundred gallons per minute. Groundwater depth decreases towards the southwest where surface water is present in the irrigated area serviced by the Orr Ditch which transports water from the Truckee River.

Transmission Pipeline Route: Soils and Geology

Transmission pipelines would carry digested sludge and phosphorous-rich supernatant from the Reno-Sparks sewage treatment plant at Vista to the proposed land reclamation and irrigation site in Spanish Springs Valley.

The proposed transmission pipeline route will cross mostly low-lying alluvium with high groundwater levels. Compressible surface soils exist between the Truckee River and the mouth of Spanish Springs Valley. These soils are Mollisols and consist of clays and silts of high shrink-swell potential with a low erosion hazard. The soils are poorly drained and have a slow to moderate permeability. Aridisol and Entisol soils are present along part of the route near the alluvial fans and mountain slopes to the east. These soils consist of clays and silts with high shrink-swell potential, are moderately erodible, and are well drained with slow permeability.

FLORA AND FAUNA

Vegetation

The service area is dominated by the Cities of Reno and Sparks and surrounding urban areas. However, the region including Truckee Meadows, the Truckee River from Verdi to Pyramid Lake, and Spanish Springs Valley has biological resources that are important to the ecology of southern Washoe County and the surrounding area.

The primary vegetation association in the area is big sagebrush grass, which gives way to pinyon juniper in the foothills. Wildlife species that utilize these remaining natural systems include the chukar in the desert and scrublands, deer which utilize the foothills for winter range, and a variety of bird species including many of which are associated with the riparian habitats along the lower Truckee River and the environs of Pyramid Lake.

The Truckee River and Pyramid Lake support a valuable fishery including the threatened Lahonton cutthroat trout and Cui-ui. The following section will describe the habitats and environments of the service area and adjacent region, discussing the occurrence and significance of the important species found there.

The macro distribution pattern of vegetation associations in Nevada is mainly dependent on climate and the ability of individual species to adapt to extreme environmental variations.

However, micro patterns are more complex, due to secondary factors such as local topography, soils, hydrology, and disturbance by man. In some areas, high concentrations of mineral salts left behind by evaporated water are generally too toxic for most plant species to grow. Overgrazing has practically eliminated annual grasses (K-4). Consequently, sagebrush communities are dominant in the rangelands. Vegetation within the study area consists of desert shrubs, trees, grasses and forbs, all or most of which can be termed phreatophytes.

Phreatrophytes are plants whose roots extend into the groundwater and consume enormous amounts of available water. Phreatophytes are present in a number of habitats including stream channels, floodplains, bottomlands, and delta areas. In the Central Lahontan Basin alone, which includes the Truckee River Subbasin, more than 530,000 acres of phreatophytes utilize more than 438,000 acre-feet of water annually, which is approximately 21 percent of the average water supply (A-1). Major phreatophytic species include black greasewood (Sarcobatus vermiculatus), rubber rabbitbrush (Chrysothamnus nauseosus), western cottonwood (Populus fremontii), willow (Salix sp.), and saltgrass (Distichlis stricta). Distribution of major phreatophytic communities in the project area includes Spanish Springs Valley, the floodplain of the lower Truckee River, and the Pyramid Lake vicinity. With the exception of the semi-agricultural areas at Verdi and Truckee Meadows, agricultural potential is limited to irrigated river bottoms and flats adjacent to the Truckee River in the Lower Truckee River Basin-Pyramid Lake area.

Plant species known to occur in the Lower Truckee River Basin-Pyramid Lake area are listed in Appendix 2. A map of major plant associations for the study area is also included in Appendix 2.

- Truckee River: State Line to Pyramid Lake

  Aquatic Macrophytes

  The aquatic macrophytes of the lower Truckee River represent plant communities that have adapted to continual environmental changes, including marginal water quality conditions, erratic flow patterns, and major stream alterations, such as channelization (I-1). Below Derby Dam on the lower Truckee River, an increase in water temperature partially attributable to the lack of riparian vegetation may inhibit some aquatic vascular plant species (R-21).

In studies conducted on the lower Truckee River in 1955 and 1975, several species of aquatic macrophytes were noted: pondweeds (Potamogeton spp.), duckweed (Lemna sp.), water fern (Azolla sp.), sedges (Carex sp.) and cattails (Typha sp.) (I-1, F-11). Waterweed (Elodea canadensis) was observed approximately 3 miles above Reno at the Mayberry Bridge in 1967, and both waterweed and pondweed were reported growing near the Lockwood Bridge below Reno in 1962 and 1967 (O-4,M-1).

In a July 1962 survey of the Truckee River, aquatic plant growth was reported to be relatively sparse at most locations sampled, although approximately 4.0 river miles downstream from Derby Dam it becomes more abundant (O-4).

Floodplain and Riparian Vegetation

A variety of plant species are found on the floodplain along the lower Truckee River because of the drop in elevation from Lake Tahoe (6,200 feet) to Pyramid Lake (3,800 feet). From the pine (Pinus spp.), northern desert shrub, and mountain brush communities above Verdi, Nevada, the river flows through the semi-agricultural area of Verdi where the northern desert shrub communities become dominant. Species present on the floodplain include black cottonwood (Populus trichocarpa), western cottonwood (Populus fremontii), jeffrey pine (Pinus jeffreyi), willow (Salix spp.), big sagebrush (Artemisia tridentata) and rabbitbrush (Chrysothamnus sp.) (R-22).

From Verdi to the Truckee Meadows area, northern desert shrub communities dominate the floodplain until indigenous vegetation is supplanted by agriculture and urbanization at Truckee Meadows. Agricultural land along the lower Truckee River supports mostly irrigated alfalfa and other forage, small grains, and produce, including wheat, barley, oats, and potatoes (R-21). Indigenous floodplain vegetation in the Reno/Sparks area has generally been replaced by ornamental species such as the Lombardy poplar (Populus italica) and elm (Ulmus sp.) (R-22). However, stands of black cottonwood, western cottonwood and willow are scattered along

the river and, in some areas, are relatively dense. Western cottonwood forms narrow, extensive groves along the lower Truckee River from Reno to Pyramid Lake (Y-1).

East of the Truckee Meadows area to the agricultural community of Wadsworth, Nevada, native floodplain vegetation includes western cottonwood, willow, phreatophytic desert shrubs such as black greasewood (Sarcobatus vermiculatus), rabbitbrush, quailbrush (Atriplex lentiformis), fourwing saltbush (Atriplex canescens) and annual grasses including inland saltgrass (Distichlis stricta) and Great Basin wildrye (Elymus cinereus).

Below Wadsworth to Pyramid Lake, the floodplain widens to form numerous oxbows. Dominant phreatophytic communities include western cottonwood with an understory of big sagebrush, black greasewood, quailbrush, fourwing saltbush, shadscale (Atriplex confertifolia), rabbitbrush, and inland saltgrass (Y-1). Agriculture is generally confined to the irrigated river bottom and flats adjacent to the Truckee River on the Pyramid Lake Indian Reservation.

Riparian Vegetation

Due to a channelization project along the lower Truckee River in the 1960's by the U. S. Army Corps of Engineers, the riparian vegetation of the river was severely reduced; since that time, overgrazing by both cattle and beaver has kept riparian plant growth at a minimum, especially between Wadsworth and Nixon, Nevada (K-3). Studies conducted on the lower Truckee River in 1974 indicated that riparian vegetation was extremely sparse except in a few areas where it has reestablished itself. A sampling location at Numana Dam was reported totally barren of riparian vegetation, leaving the river banks exposed over most of the area (K-3).

- Steamboat Creek

Due to the paucity of information on the aquatic biota of Steamboat Creek, aquatic vascular plant communities cannot be adequately characterized. Species diversity and abundance probably reflect that of the lower Truckee River, although water quality

degradation of Steamboat Creek may inhibit some species' growth. Aquatic vascular plants most likely to occur in Steamboat Creek include cattail (Typha sp.), pondweed (Potamogeton sp.), sedges (Carex sp.) and water fern (Azolla sp.) (E-2).

- Truckee Meadows

The Truckee Meadows area supports two basic types of plant communities: natural and irrigated meadows, and rather severely degraded sagebrush communities. The natural meadows are generally composed of either saline and/or alkaline soils which support phreatophyte species such as saltgrass, rabbitbrush and greasewood. The irrigated meadows, as opposed to the natural meadows, are irrigated by water diverted from the Truckee River (Y-1). A certain amount of agriculture still persists in this area, remnants of a once propsering farming region. However, the USDA River Basin Planning Staff projects that by 1978, irrigated crop production will disappear from the Truckee Meadows area (E-2). The actual reduction has been slower than predicted. Plant species present in the irrigated meadows include sedges, Baltic rush (Juncus balticus) and various grasses (Y-1).

Many of the sagebrush communities in the vacant lots and wastelands in Truckee Meadows have been degraded by replacement with annual weeds, the result of present annual clearing requirements to reduce fire hazards. Consequently, plant communities are continuously kept to a low seral stage. Despite annual weed control, alien plant species, often noxious to man and livestock, thrive in this area. Russian thistle (Salsola kali), which is highly allergenic to man, tumbleweed (Sisymbrium altissimum), and cheatgrass (Bromus tectorum) are dominant species inhabiting the burned areas. Outside Truckee Meadows, noxious species inhabiting degraded big sagebrush communities include rabbitbrush, horsebrush (Tetradymia spp.) and desert peach (Prunus andersonii) (Y-1).

- Spanish Springs Valley

Vegetation in the Spanish Springs Valley area is mainly a big sagebrush-grass association typical of the vegetation communities that cover approximately

37 percent of range and woodland in the Truckee River Subbasin (A-1). In some areas, such as Mustang and Prospect Ridge north of Reno, this association has been reduced to native perennial grass and forb communities as a result of past overgrazing practices (Y-1). Dominant species of the big sagebrush-grass association include big sagebrush, spiny hopsage (Grayia spinosa), Nevada ephedra (Ephedra nevadensis), littleleaf horsebrush (Tetradymia glabrata), and antelope bitterbrush (Purshia tridentata). Grasses present include species of the needlegrass (Stipa spp.), wheatgrass (Agropyron spp.), oniongrass (Melica spp.), and bluegrass (Poa spp.) genera. Indian ricegrass (Oryzopsis hymenoides) and bottlebrush squirreltail (Sitanion hystrix) may also be present. Forb species generally present include lupine (Lupinus sp.), hawksbeard (Crepis sp.), balsam root (Balsamorhiza sagittata), locoweed (Astragalus sp.), buckwheat (Eriogonum sp.), and phlox (Phlox sp.).

The bottomlands of Spanish Springs Valley primarily support communities of rabbitbrush and greasewood in contrast to the big sagebrush-grass association. Dominant phreatophytes include rubber rabbitbrush (Chrysothamnus nauseosus), black greasewood, western cottonwood, willow, and rose (Rosa sp.). Phreatophytic grasses include saltgrass (Distichlis stricta), creeping wildrye (Elymus triticoides), and wiregrass (Juncus sp.) (A-1).

- Pyramid Lake Basin

The vegetation of the Pyramid Lake Basin is very sparse and scattered as a result of the limitations of an extreme environment. Desert environments are relatively sensitive to changes caused by man, and recovery rates are very slow (I-1).

Aquatic Macrophytes

The turbidity and salinity of Pyramid Lake exert a strong influence on the aquatic macrophytic communities of the lake. Where these communities exist, they are comprised of species that have adapted to the high concentration of dissolved organic salts in the lake waters. Species which have been reported to occur in inland open saline waters in Nevada include sago pondweed (Potamogeton pectinatus), widgeongrass (Ruppia maritima), and muskgrass (Chara sp.) (I-1).

Riparian and Floodplain Vegetation

Riparian communities bordering Pyramid Lake are generally sparse (R-23). The desert sagebrush associations extend from the Truckee River all the way to the shoreline of Pyramid Lake (E-2).

Three dominant vegetative types inhabit areas above the shoreline of Pyramid Lake. The big sagebrush-grass type covers the majority of the region to the south, west, and east of the lake. The mixed desert shrub association is dominant along the southeastern portion of the lake, and clumps of annual weeds are present along the shore in the northern and southeast sections.

The big sagebrush-grass association that dominates the majority of the acreage surrounding Pyramid Lake is composed of such species as big sagebrush, spiny hopsage and antelope bitterbrush, grasses including needle grass, wheatgrass, and bluegrass, and forbs such as lupine, hawksbeard, and locoweed.

Locations to the north, northwest, and southeast of Pyramid Lake provide habitat for communities of annual weeds. These associations often grow in such dense communities that perennial plant growth is inhibited. Areas dominated by annual weeds are generally grazed by livestock. Principal species of the annual weed communities include bassia (*Bassia hyssopifolia*), Russian thistle and scattered communities of inland saltgrass (*Distichlis stricta*).

The mixed desert shrub vegetative type is generally found along the eastern and northwestern areas of Pyramid Lake above the shoreline. Dominant species include upland greasewood (*Sarcobatus baileyi*), shadscale, bud sagebrush (*Artemisia spinescens*), various species of rabbitbrush (*Chrysothamnus* spp.), spiny hopsage, Nevada dalea (*Dalea polyadenia*), littleleaf horsebrush (*Tetradymia glabrata*), gray horsebrush (*Tetradymia canescens*), Nevada ephedra and burrobrush (*Hymenoclea monogyra*). Grasses and forbs occurring in this area are widely scattered, but may include bottlebrush squirreltail (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*), foxtail brome (*Bromus rubens*), pepperweed (*Lepidium* sp.), and tumbleweed (*Sisymbrium altissimum*) (A-1).

- Anaho Island

Approximately 750 acres of land rising 600 feet out of the waters of Pyramid Lake comprise what is known as Anaho Island (A-1,I-1). The topography of the island varies from gently sloping shoreline to steep, rugged uplands, from small basins to rocky crags. A natural land bridge, lying approximately 30 feet below the present lake surface, connects the island to the shores of Pyramid Lake (I-1).

The vegetation of Anaho Island has not been subjected to grazing pressure by domestic livestock for at least the past 80 years and, consequently, vegetation communities have remained virtually undisturbed by the influence of man.

In 1966, the vegetation of Anaho Island was inventoried and 45 plant species and subspecies were identified (W-9). Shrub species reported on the island include shadscale, fourwing saltbrush, spiny hopsage, black greasewood, little leaf horsebrush, winterfat (Eurotia lanata), and rabbitbrush. Shadscale communities were noted to be confined to the shallower, rocky soils at lower elevations, while spiny hopsage was present in the draws and basins on deeper soils (A-1,W-9).

Although big sagebrush is the dominant component of the vegetation association surrounding Pyramid Lake, the shrub is not abundant on Anaho Island and only an isolated group of three large plants was reported (W-9). Eight species of grasses are reported to occur on the island: three species of brome including foxtail brome (Bromus rubens), B. rigidis, and cheatgrass (B. tectorum var. glabrata); bottlebrush squirreltail (Sitanion hystrix); desert needlegrass (Stipa speciosa); saltgrass (Distichlis stricta); and two species of barley (Hordeum spp.) (W-9). The most abundant grasses appear to be cheatgrass and saltgrass.

Numerous species of forbs are present on the island including bassia (Bassia hyssopifolia), evening primrose (Oenothera boothii, O. clavaeformis), Russian thistle (Salsola kali), filaree (Erodium cicutarium) and locoweed (Astragalus lentiginosis, A. utahensis) (W-9).

Terrestrial Fauna

The Lower Truckee River Pyramid Lake Basin has a significant variety of habitats for all types of wildlife. Many locations in the study area are vital for wildlife preservation and some areas, such as Truckee Meadows, provide environments unique to the basin. All water bodies in the project area including the Truckee River, Steamboat Creek, the wetlands of Spanish Springs Valley, and Pyramid Lake are important for the protection and preservation of wildlife (R-25). Small ponds and lakes provide habitat for migratory waterfowl, shorebirds, small mammals, and herptiles. Streams and rivers support species of furbearers and songbirds.

Agricultural areas in the project area supply ample food for many species of wildlife. Species known to occur in the Lower Truckee River Basin-Pyramid Lake project area are listed in Appendix 3. These species are generally found only in scattered or isolated locations where their respective habitats are available.

The following information is based upon a number of general sources including other environmental reports, general publications of the Nevada Department of Natural Resources, and various planning documents. Faunal surveys or detailed studies of the wildlife within the Lower Truckee River Basin, particularly the specific sites proposed for construction and/or modification are, for the most part, unavailable. Therefore, much of the following information is based upon a habitat approach which characterizes the faunal communities within the various habitats in the area, many of which have a history of man-induced modifications.

- Truckee River: State Line to Pyramid Lake

  The cottonwood, willow, and northern desert shrub communities which characterize much of the floodplain of the Truckee River provide adequate habitat for a variety of wildlife species. However, encroachments upon habitat as a result of urbanization and development have limited wildlife populations, particularly in the vicinity of Reno-Sparks. Habitat destruction often forces wildlife into higher elevations, making survival in the winter months difficult.

The few wildlife species which inhabit metropolitan areas include songbirds such as the robin (Turdus migratorius) and the house sparrow (Passer domesticus), the mourning dove, rats, mice, and ground squirrels (Spermophilus spp.) (E-2).

Mammals

The area west of Reno along the lower Truckee River provides vital winter habitat for mule deer (Odocoileus hemionus), an important big game species. Evidence of mule deer occurring along the lower Truckee River was reported approximately 1 mile upstream from the Nixon USGS gauging station in 1974 (K-3). This area is also the only mink (Mustela vison) habitat in Washoe County aside from Steamboat Creek (R-25,B-6).

Big game species such as black bear (Ursus americanus) and mountain lion (Felis concolor) are generally confined to mountainous areas outside of the project area. However, mule deer ranges extend into the project area along the Truckee River west of Reno (S-20) at locations where browse plants are readily available.

Other mammals reported to occur along the lower Truckee River include muskrat (Ondatra zibethicas), river otter (Lutra canadensis), badger (Taxidea taxus), long-tailed weasel (Mustela frenata) and ermine (Mustela erminea) (S-20,E-2,I-1). Beaver (Castor canadensis) populations have increased in this area as a result of the lack of natural predators. Consequently, riparian vegetation of the lower Truckee River has been severely reduced due to overgrazing by beaver (K-3).

Birds

The Truckee River between Verdi and Reno provides habitat for several rare bird species (e.g., water ouzel, raptors) that over-winter but are not indigenous to the area. These populations rely on the adjacent fields for food and nesting. Although the water ouzel (Cinclus mexicanus) is not native to this area, it often over-winters along the lower Truckee River (B-6).

Avian species such as the great blue heron (Ardea herodias), the double-crested cormorant (Phalacrocorax auritus), and several species of duck including the

common merganser (Mergus merganser) and the hooded merganser (Lophodytes cucullatus), coots (Fulica americana), and geese have been reported to occur along the lower Truckee River (I-1,F-11). Other waterbirds inhabiting this area include the pied-billed grebe (Podilymbus podiceps), the American bittern (Botaurus lentiginosus), and the California gull (Larus californicus) (I-1,F-11). Small game birds such as the sage grouse (Centrocercus urophasianus), the ring-necked pheasant (Phasianus colchicus), the chukar partridge (Alectoris chukar), mourning dove (Zenaidura macroura), and California quail (Lophortyx californicus) are present along the lower Truckee River (S-20). The chukar partridge was introduced into Nevada in the 1940's and 1950's, and has adapted sufficiently to the new environment to become quite common in some areas. Unfortunately, habitat destruction resulting from urbanization has resulted in the decline of both sage grouse and pheasant populations (A-1).

Herptiles

Reptiles and amphibians (collectively termed herptiles) of the lower Truckee River have not been reported to be abundant, probably as a result of the limited amount of cover found in many areas along the river. Areas of relatively quiet water with abundant growths of aquatic vegetation and cattails provide habitat for the bullfrog (Rana catesbeiana) and the leopard frog (Rana pipiens), which were reported in the area in 1946 and in 1973 along the lower Truckee River drainages (S-20,F-1). Several species of snakes, including the garter snake (Thamnophis spp.), inhabit the lower Truckee River area (I-1,F-11). In places, habitat is available for a variety of reptilian species known to occur in the area. However, no surveys for those areas are available.

- Steamboat Creek

Wildlife species associated with flowing water habitats include herons, ducks, the spotted sandpiper (Thamnophis spp.), and frogs (such as the bullfrog) (E-2). Mink are also found in the Steamboat Creek area (R-25).

- Truckee Meadows

The Truckee Meadows area is unique in that even though it is in close proximity to Reno and Sparks, a number of rare and endangered species (i.e., southern bald eagle) have been sighted in this area (B-6).

Mammals

Marshy areas south of Pembroke provide suitable habitat for a number of mammalian species associated with wetlands, such as mink, beaver and otter. The agricultural croplands support the small rodents upon which raptors and other wildlife species feed, particularly during winter months when mountain areas are snowbound.

Birds

The Truckee Meadows area is considered vitally important as an over-wintering location for migratory waterfowl and raptors. It is not unusual to observe 100 to 125 raptors during the winter in the area east of Boynton Lane. The only other comparable habitat in Nevada is found in Carson Valley (B-6). Raptors frequenting this area generally include owls, falcons, and hawks. The region west of Boynton Lane is also utilized as a feeding ground for many avian species.

Migratory waterfowl such as geese, ducks, and loons over-winter in Truckee Meadows as well as at Virginia Lake. A once important Canada goose winter feeding habitat in Truckee Meadows was converted into housing developments (B-6). Game birds observed in Truckee Meadows include ring-necked pheasant, chukar partridge, and California quail (S-20).

Herptiles

Irrigation ditches and water drainages in Truckee Meadows generally provide adequate habitat for amphibians such as the bullfrog and leopard frog. Dr. Ira LaRivers (L-4) has compiled a list of reptiles and amphibians known historically from the Truckee Meadows area. This tabulation is presented in Appendix 3.

- Spanish Springs Valley

The Spanish Springs Valley area, characterized by the dominant big sagebrush-grass association and intermittent small ponds, supports a variety of wildlife species.

Mammals

Mammals in the valley are typical of areas dominated by big sagebrush. Small herbivorous rodents, such as pocket mice (Perognathus spp.) and kangaroo rats (Dipodomys spp., Microdipodops sp.), are the most prominent mammalian species. Ground squirrels (Spermophilus spp.) are wide-spread in this habitat, but "are sometimes locally restricted" (I-1). Blacktail jackrabbits (Lepus californicus) are also present in the open areas with reported average numbers ranging from less than 0.1 to 0.5 per hectare (I-1).

Birds

Few species of birds inhabit the big sagebrush area and population densities are generally low. The number of birds occupying 40 hectares (100 acres) may increase to 108 in washes or near water, but declines to 0 to 37 individuals in open desert (I-1). Birds characteristic of sagebrush scrub communities include magpie (Pica pica), vesper sparrow (Pooécetes gramineus), and Brewer's sparrow (Spizella breweri). Ducks, loons, and shorebirds may be common near the ponds (E-2). Waterfowl is hunted at several ponds in the area (F-12).

Herptiles

Amphibians are not abundant in the big sagebrush vegetation zone due to climatic and habitat restrictions.

Reptiles are the most prevalent vertebrate animals other than small, herbivorous mammals that inhabit the big sagebrush community. Based on sight observations, an average of 6.5 lizards per hectare (2.6 acres) are found in the summer months in this habitat (I-1). Lizards such as the northern desert horned lizard (Phrynosoma platyrhinos) and species which prefer the

flat, open terrain with sparse plant cover dominate the Spanish Springs Valley area. Several species of snakes are also present. The herptilian fauna for Spanish Springs is very likely similar to that found in Truckee Meadows.

- Pyramid Lake

Mammals

Mammals inhabiting the big sagebrush-grass communities surrounding most of Pyramid Lake are generally smaller species which have adapted to sparse vegetative cover, such as small herbivorous rodents. Mammals reported in the vicinity of Pyramid Lake include the coyote (Canis latrans); rabbits such as the pygmy rabbit (Syvilagus idahoensis), blacktail jackrabbit (Lepus californicus) and the whitetail jackrabbit (Lynx rufus); and several species of rodents including kangaroo rats (e.g., Dipodomys microps and the white-tail antelope squirrel, Ammospermophilus leucurus) (I-1,W-10,R-21). Big game species, particularly mule deer (Odocoileus hemionus), are generally confined to the bordering mountain ranges of the Virginia Mountains on the west and the Lake Range to the east (W-10).

Birds

Pyramid Lake provides a feeding ground for the many fish-eating birds which inhabit Anaho Island, such as the double-crested cormorant and the white pelican. This area also provides one of the largest refuge areas for moulting waterfowl (E-2). Pyramid Lake is an important Canada goose (Branta canadensis) habitat (E-2). The slopes and canyons edging the valley support small populations of chukar partridge and California quail. Although the southern bald eagle (Haliaeetus l. leucocephalus) and the peregrine falcon (Falco peregrinus), both listed as endangered species, have been reported to nest in this area, there are no records of nesting in recent years (I-1).

Herptiles

Only three species of amphibians are known to occur in the Lower Truckee River Basin, including Pyramid Lake: the bullfrog, the leopard frog, and the Great Basin spadefoot toad (Scaphiopus intermontanus) (I-1). Arid

conditions and high concentrations of dissolved organic salts may be the causes of the limited amphibian populations.

Several species of reptiles, primarily lizards and snakes, have been reported in the Pyramid Lake vicinity (I-1,W-10). Reptiles inhabiting the open, semi-arid desert areas include the northern desert horned lizard (Phrynosoma platyrhinos), the Great Basin whiptail (Cnemidophorus tigris), the collared lizard (Crotaphytus collaris), and the long-nosed leopard lizard (Crotaphytus wislizenii). The Great Basin rattlesnake (Crotalus viridus lutosus) is the only poisonous snake indigenous to northern Nevada (W-10, W-9).

- Anaho Island

Anaho Island, a rugged land mass of approximately 750 acres, rises out of Pyramid Lake some 600 feet. The island is a major remnant of the Pleistocene Lake Lahontan and is interesting from an ecological viewpoint because of its history of isolation from the surrounding basin. In 1913, President Woodrow Wilson designated Anaho Island a National Wildlife Refuge. It serves primarily as a nesting and breeding ground for several thousand white pelicans (Pelecanus erythrorhynchos) and other bird species. Preservation of Anaho Island is a matter of growing concern because the level of Pyramid Lake continues to decline. As the lake recedes, the island becomes more exposed, which will eventually provide easier access for natural predators. The most comprehensive study of Anaho Island is a study by W. Verne Woodbury (W-9) which serves as the basis of the following description.

Mammals

The number of mammalian species inhabiting Anaho Island is very limited. Trapping data from the U. S. Fish and Wildlife Service in 1963 showed that four genera of small mammals had been taken: pocket mice (Perognathus sp.), deer mice (Peromyscus maniculatus), woodrats (Neotoma sp.), and kangaroo rats (Dipodomys sp.). Trappings from 1963 to 1965 only produced deer mice (W-9).

In the upper elevations on Anaho Island, numerous caves and crevices provide suitable habitats for bats. Although bats have not been reported to roost in the area, they have been seen flying at dusk (W-9).

Evidence of coyote on the island was discovered in December 1965, but no animal was actually seen (W-9). Remains of domestic sheep were also found on the island, indicating the introduction of grazing animals at some time in the past (A-1,W-9).

Birds

Anaho Island is one of the two largest white pelican rookeries in North America (R-21). In the spring, (generally in March), the birds arrive at Anaho Island and remain until fall when the majority of the population migrates to the western coastal areas of Mexico (W-9). In the warm, summer months, it is not unusual for 8,000 white pelicans to be sighted on the island (I-1). The rookery was productive long before the white man arrived in the basin. It is in danger due to the receding level of Pyramid Lake and the ultimate joining of Anaho Island to the lake shoreline which would allow easy access for predators and man.

Other waterbirds inhabiting the island include California gulls (Larus californicus), double-crested cormorants (Phalacrocorax auritus), great blue herons (Ardea herodias), and Caspian terns (Hydroprogne caspia) (I-1,W-9). Both the double-crested cormorant and Caspian tern have apparently only nested on the island within recent years (W-9). Total numbers of birds congregating on Anaho Island in summer months often reaches 15,000 individuals (I-1). Other bird species reported on or near the island include (W-9): eared grebe (Podiceps caspicus), western grebe (Aechmophorus occidentalis), Canada goose (Branta canadensis) and mallards (Anas platyrhynchos). Bird species observed on or near Anaho Island are listed in Appendix 3.

Herptiles

Populations of amphibians at Pyramid Lake are extremely sparse, perhaps because of the arid environment and the lake's salinity. Only a single western spadefoot toad (Scaphiopus hammondi) has been observed on the island (W-9).

Several species of lizards, including the northern side-blotched lizard (Uta stansburiana stansburiana), the desert spiny lizard (Sceloporus magister), the Great Basin whiptail (Cnemidophorus tigris tigris), the zebra-tailed lizard (Callisaurus dracoides) and one specimen of the desert horned lizard (Phrynosoma platyrhinos platyrhinos) were reported on Anaho Island (I-1,W-9).

There is only one poisonous snake indigenous to northern Nevada: the Great Basin rattlesnake (Crotalus viridis lutosus). It occurs on Anaho Island in relative abundance compared with other snake species on the island; i.e., the gopher snake (Pituophis catenifer), the desert striped whipsnake (Masticophis taeniatus), and the western garter snake (Thamnophis elegans) (W-9).

Aquatic Fauna

- Truckee River: State Line to Pyramid Lake

Plankton

Little research has been done on plankton flora and fauna in the lower Truckee River. However, it is known that plankters increase in variety and number at progressively lower points on the river (L-4). In the slower, wider reaches downstream, higher water temperature, increased dissolved solids, reduced velocity and more backwaters promote plankton production. Phytoplankton, particularly diatoms, are most abundant (L-4). A list of algae, including phytoplankton, collected during a study in 1972 is found in Appendix 3. Among the known zooplankton are members of Copepoda, Cladocera, Ostracoda, and Rotifera. A more recent summary of phytoplankton collections taken from the River near Nixon, Nevada, lists codominants over an 11-month period (see Table 2-L).

Plankton are by definition a passively drifting fauna and flora subject to the transporting action of waves and currents. As a result, they are not considered a good indication of stream conditions (E-17). They are, however, an important food source for the benthic or bottom dwelling macroinvertebrates and some fish.

TABLE 2-L

A SUMMARY OF PHYTOPLANKTON ANALYSIS
OF TRUCKEE RIVER SAMPLING NEAR NIXON, NEVADA

Date	Codominants	Total Cells (ml)	Percentage of Total
74 11 12	Nitzschia	3,200	31
	Navicula		26
74 12 11	Navicula	980	34
	Nitzschia		29
	Diatoma		24
75 01 22	Navicula	1,900	36
	Achnanthes		34
75 02 19	Cyclotella	2,300	40
	Navicula		31
75 03 25	Lyngbya	14,000	30
	Cyclotella		21
75 04 23	Navicula	7,700	31
	Nitzschia		18
75 05 29	Navicula	3,600	27
	Melosira		18
	Cyclotella		18
75 06 17	Navicula	3,400	33
75 07 23	Navicula	7,600	33
	Oscillatoria		29
75 08 20	Nitzschia	4,700	30
	Navicula		24
	Cymbella		15
75 09 19	Melosira	5,000	26
	Navicula		24
	Nitzschia		24
	Fragilaria		18

Source: (I-3)

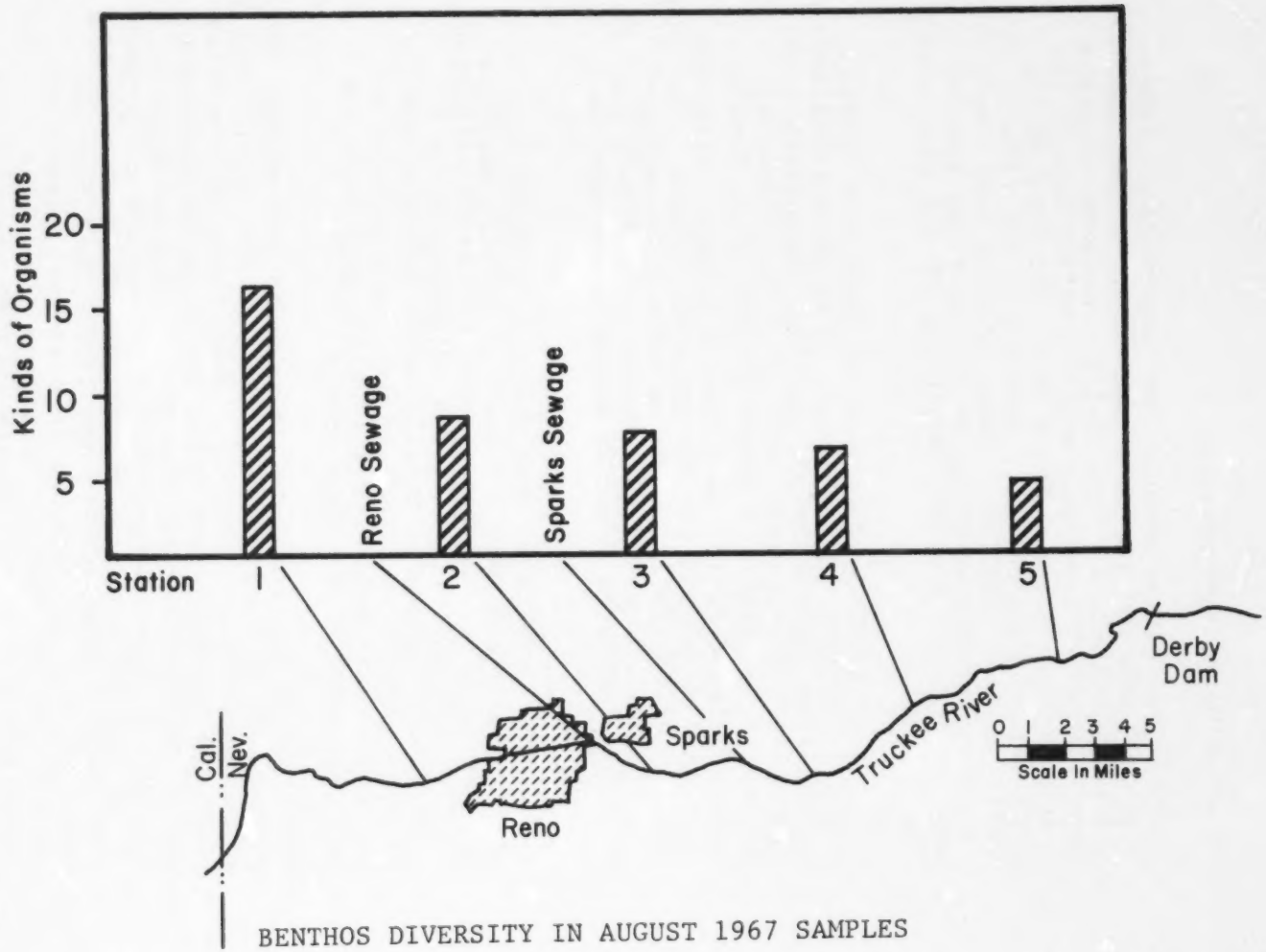
Benthic Macroinvertebrates

Benthic macroinvertebrates are significant members of the food web and are important to the higher aquatic forms, particularly fish (E-17). Several investigators have studied the benthic macroinvertebrates of the lower Truckee River. Myers (M-1) and Buoy (B-17) implemented complementary studies on the effects of pollution upon benthos. These studies were based on periodic benthos sampling at stations upstream of Reno and up to 20 miles downstream of the city (see Figure 2-8).

At station 1, (3.4 miles west of Reno city limits), Myers found four insect orders to be most prevalent: caddisflies (Trichoptera), mayflies (Ephemeroptera), stoneflies (Plecoptera), and trueflies (Diptera). At station 4, about 13 miles downstream of Reno's sewage release (1967) at McCarran Bridge, there was much less diversity but far greater numbers. The large numbers of tubificids found at this site indicate organic enrichment of the stream. A complete list of macroinvertebrates found by Myers is included in Appendix 3.

Myers (M-1) concluded that downstream pollution severely reduced insect variety. Certain mayflies (*Ephemerella* sp. and *Baetis* sp.) tolerated pollution in reduced numbers; caddisfly (*Hydropsyche* sp.) populations increased greatly under polluted conditions; trueflies (*Tendipedidae*) were pollution-tolerant; and sludge worms (*Tubificidae*) were the most abundant of the four orders.

Myers' study was completed before the Reno-Sparks JWPCP was completely constructed. Buoy's study (B-17) was conducted after plant start-up. Buoy found that species diversity had increased while the relative abundance had decreased from that observed by Myers. Buoy attributed these changes to the processing efficiency of the new JWPCP and to an increase in Truckee River flow volumes between 1966 and 1967. Both factors contributed to an increase in dissolved oxygen available to benthic organisms and a decrease in stream pollution. A complete list of macroinvertebrates found by Buoy is included in Appendix 3.



BENTHOS DIVERSITY IN AUGUST 1967 SAMPLES

Source: (M-1)

Figure 2-8

The most recent research was performed by Koch and Hainline (K-8) during the period September 1973 through December 1975. Stream flows were higher and more consistent during the study than during previous research on benthic macroinvertebrates. The results of the Koch and Hainline study indicated a significant reduction in the extent of habitat degradation in the lower Truckee River. There was a presumably normal successional process of increased number of organisms per stream substrate area in a downstream direction, while organism diversity decreased. The family Hydropsychidae was dominant in cold months while Baetidae dominated in warmer months. Oligochaetes found in previous studies at downstream stations were not observed indicating less degradation. This was probably due to the diluting effect of increased river flows (K-8). The dominant benthic macroinvertebrates collected at the lower river stations in 1973 and 1974 are listed in Tables 2-M and 2-N. Twice during the study, benthic organism numbers were severely reduced at the two nearest stations downstream of Derby Dam following the procedures of flushing silt from the dam's backpool. Six months were required for repopulation of the affected stream reach. The effects of the siltation is illustrated in Figure 2-9 showing population fluctuations during the study period.

Fish

Environmental conditions in the Truckee River from the California-Nevada state line to the Ceresola Ranch are subject to the controls of numerical water quality standards discussed in Chapter 3. The standards established were designed to protect a high quality stream. The river reach from the state line to just west of Reno supports aquatic life and fish spawning activities (W-1). Much of this reach has considerable gradient and is relatively shallow with riffles.

The substrate consists primarily of rubble or larger rock (F-6). The banks are frequently undercut and bank vegetation offers some cover. Benthic macroinvertebrates, (the fish community's principal food), are plentiful and diverse. Forage fish are available to larger fish as food.

TABLE 2-M

LOWER TRUCKEE RIVER BENTHIC MACROINVERTEBRATE DOMINANT ORDER, FAMILY AND GENUS - 1973

Station[a]	No./m^2	Dominant Order	% of Total	Dominant Family	Total No. Families	Dominant Order	% of Total	Total No. Genera
				September 1973				
6	281.9	Trichoptera	65	Hydropsychidae	6	Cheumatopsyche	39	13
7	204.2	Ephemeroptera	67	Baetidae	8	Tricorythodes	61	14
9	925.7	Trichoptera	83	Hydropsychidae	6	Hydropsyche	69	9
10	224.2	Trichoptera	25	Hydropsychidae	7	Hydropsyche	25	7
11	130.9	Ephemeroptera	59	Baetidae	4	Tricorythodes	46	5
				October 1973				
6	805.8	Trichoptera	92	Hydropsychidae	9	Cheumatopsyche	45	10
						Hydropsyche	10	
7	71.0	Ephemeroptera	28	Baetidae	7	Tricorythodes	13	7
		Trichoptera	13			Hydropsyche	13	
9	1884.8	Trichoptera	95	Hydropsychidae	5	Hydropsyche	74	6
10	488.4	Trichoptera	75	Hydropsychidae	8	Hydropsyche	67	9
11	777.	Trichoptera	76	Hydropsychidae	8	Hydropsyche	56	8
				December 1973				
6	246.4	Trichoptera	74	Hydropsychidae	5	Hydropsyche	41	8
7	401.8	Trichoptera	66	Hydropsychidae	9	Hydropsyche	66	12
8	66.6	Trichoptera	57	Hydropsychidae	3	Hydropsyche	57	3
9	266.4	Trichoptera	86	Hydropsychidae	9	Hydropsyche	81	11
10	53.3	Ephemeroptera	54	Baetidae	9	Baetis	54	9
11	586.1	Ephemeroptera	67	Baetidae	9	Baetis	65	10

NOTES: [a] Sampling station locations:
6. Just below Verdi.
7. University Agricultural Station - Reno.
9. Below Derby Dam.
10. Below Wadsworth.
11. Immediately above Nixon.

Source: (K-8)

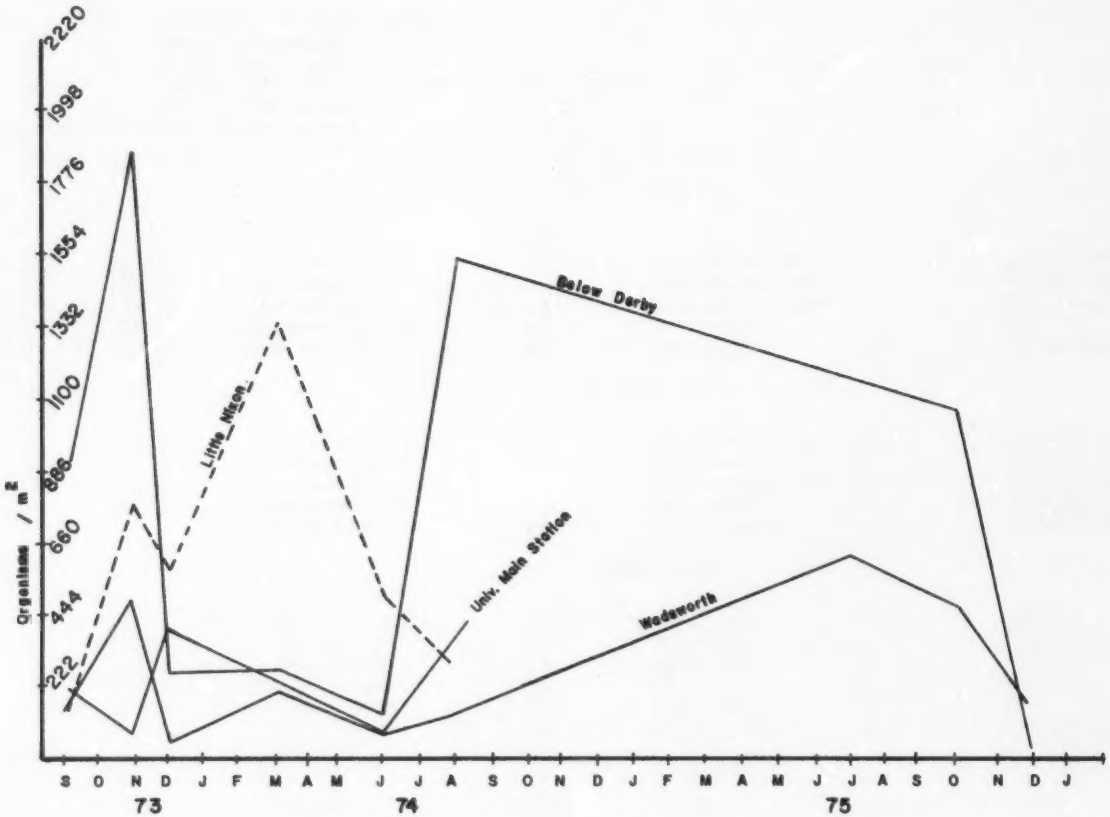
TABLE 2-N

LOWER TRUCKEE RIVER BENTHIC MACROINVERTEBRATE DOMINANT ORDER, FAMILY AND GENUS - 1974

Station[a]	No./m^2	Dominant Order	% of Total	Dominant Family	Total No. Families	Dominant Order	% of Total	Total No. Genera
				March 1974				
6	131.0	Ephemeroptera	53	Baetidae	8	Heptagenia	19	10
		Plecoptera				Arcynopteryx	17	
7	244.2	Plecoptera	33	Perlodidae	9	Arcynopteryx	33	11
8	28.9	Opisthopora	50	Lumbricidae	4	--		4
9	281.9	Ephemeroptera	58	Baetidae	7	Baetis	56	8
10	204.2	Ephemeroptera	76	Baetidae	5	Baetis	76	5
11	1336.4	Trichoptera	38	Hydropsychidae	8	Hydropsyche	37	6
		Ephemeroptera	37	Baetidae	5	Baetis	36	
				June 1974				
6		Plecoptera	65	Perlodidae	7	Arcynopteryx	30	9
7	248.6	Ephemeroptera	70	Baetidae	5	Ephemerella	70	5
9	137.6	Trichoptera	68	Hydropsychidae	4	Hydropsyche	50	6
10	71.0	Ephemeroptera	53	Baetidae	3	Hydropsyche	34	5
11	508.4	Trichoptera	87	Hydroptilidae	6	Hydropsyche	79	9
				October 1974				
6	175.4	Plecoptera	48	Perlodidae	11	Arcynopteryx	46	12
7	395.2	Ephemeroptera	62	Baetidae	7	Baetis	46	10
9	1534.0	Trichoptera	93	Hydropsychidae	6	Hydropshche	81	7
10	126.5	Trichoptera	56	Hydropsychidae	5	Hydropsyche	56	7
11	284.2	Trichoptera	72	Hydropsychidae	4	Hydropsyche	72	4

NOTES: [a] Sampling station locations:
6. Just below Verdi.
7. University Agricultural Station - Reno.
9. Below Derby Dam.
10. Below Wadsworth.
11. Immediately above Nixon.

Source: (K-8)



BENTHIC MACROINVERTEBRATE POPULATION
FLUCTUATIONS IN THE LOWER TRUCKEE RIVER 1973-1975

Source: (K-8)

Figure 2-9

The community in this reach is diverse, indicating a stable, desert foothills stream ecosystem. Surveys have recorded the natural spawning of mountain whitefish (Prosopium williamsoni), rainbow trout (Salmo gairdneri), and brown trout (Salmo trutta) (F-6) in addition to that of forage species. Considerable stocking of salmonid fish species is performed periodically by the State Department of Fish and Game (F-6,E-2). Angling in this reach is very popular.

The river reach between the Reno-Sparks urban area and the Derby Dam suffers from a rather marked deterioration of water quality resulting largely from residential, industrial, municipal and agricultural land uses (I-1). The river at Reno was found to have a balanced biological environment, supporting trout and other coldwater fish species (O-3).

Treated sewage effluent from the Reno-Sparks JWPCP that flows into the Truckee River via Steamboat Creek has the most significant pollutant impact upon the fish community of this river reach. Monthly water quality data (W-1) gathered since 1966 at points above and below the mouth of Steamboat Creek show that the Reno-Sparks JWPCP effluent is a major contributor to stream biological oxygen demand; that total phosphate levels currently equal or exceed state standards; that nitrate concentrations approach state standard levels with the JWPCP the principal contributor; that TDS levels, originating from the Reno area and Steamboat Creek, exceed state standards. No known fishery sampling survey data which specifically demonstrates the effects of pollutants entering the river from Steamboat Creek is available (O-4). However, research on benthic macroinvertebrate populations in the affected reach (M-1,B-17,E-2) shows that numbers of aquatic fauna are depressed. It is, therefore, reasonable to assume that the immediate river reach below Steamboat Creek exhibits reduced fish species diversity and abundance (K-4).

Many anglers use the river reach between Reno and Derby Dam for sport fishing. This reach is periodically stocked with trout, channel catfish (Ictalurus punctulatus), black bullhead (Scatalurus melas), largemouth black bass (Micropterus salmoides), and crappie (Pomoxis sp.) (E-2). Table 2-O presents

TABLE 2-O

FISH STOCKING DATA
TRUCKEE RIVER AND PYRAMID LAKE
1972 AND 1975

1972 (E-2)

Truckee River (from California border to Reno, Nevada)

Rainbow trout	97,028 catchables
Brook trout	36,346 catchables
Brown trout	35,436 catchables

Lower Truckee River

Lahontan cutthroat trout	83,990 fingerlings

Pyramid Lake

Lahontan cutthroat trout	112,460 fingerlings

1975 (S-29)

Lower Truckee River

Lahontan cutthroat trout	809,641 all sizes

Pyramid Lake

Lahontan cutthroat trout	482,703 catchables
	1,125 catchable hybrids
	289,329 fingerlings

Source: (E-2, S-29)

stocking data for 1972 and 1975. The water quality of the river reach from Derby Dam to Ceresola Ranch is subject to the controls defined in Chapter 3; from Ceresola Ranch to the river mouth the controls specified for a Class C stream are in effect (ref. letter - NEVEPS). Because of elevated water temperature (particularly during summer low flow), recent reduced annual flow velocity, increasing TDS levels, stream channelization (loss of cover) and siltation of spawning beds, this river reach has become marginal trout habitat, especially with regard to spawning activity (I-1, J-1). Sampling surveys in 1971 found the native sucker and minnow species to be the most numerous (J-1). As of 1971, the combination of elevated summer water temperature and decreased river flow had favored establishment of a warm water environment conducive to the development of warm water and rough species fishery (J-1). However, the minimum fishery flows beginning in 1972 "have greatly improved the trout habitat in the lower river" (King, D.J., Field Supervisor, Fish and Wildlife Service, Reno - letter to City of Reno, August 23, 1976).

A report by the USEPA (F-2) states that the widely publicized decline of the endangered Lahontan cutthroat trout fishery in the river is:

> due principally to the delta at the mouth of the Truckee River, and the fact that in the springtime there is insufficient flow in the river to provide passage upstream to allow these fish access to their natural spawning grounds. Marble Bluff Dam and Pyramid Lake Fishway, which are now under construction, will correct that condition.

The fishway is now in place and initial use should occur in the spring of 1976. The endangered fish species, Cui-ui lakesucker (Chasmistes cujus), that also would normally migrate up the river to spawn, will also utilize and benefit from the new fishway (R-21).

Data collected on the trout spawning potential of the river reach between Numana and Derby Dam indicates poor spawning conditions, primarily due to the fine sediment compaction of the spawning bed gravel, erratic water flows, and reduced levels of dissolved oxygen (M-2). If proper trout incubation water

temperatures (below 58°F) can be maintained from March to mid-May, and other environmental factors are suitable, then egg incubation should succeed (M-2). Recent data indicates that increased river flows resulting from a recent court decision on basin water regulation have greatly improved habitat conditions. During this recent period only two obstructions remained in the river that would act as a barrier to upstream migrations of endemic fish species. These remaining obstructions were the Derby Dam and structures at Wingfield Park.

Significant angling activity has been observed on the river as far downstream as Nixon, Nevada (E-2). Cutthroat trout stocking of waters in this reach was performed as recently as 1974 (F-6,F-8). A complete listing of fish species known or expected to occur in the lower Truckee River is included in Appendix 3.

- Truckee Meadows - Steamboat Creek

The only significant, natural waterway in the Truckee Meadow area, other than the Truckee River, is Steamboat Creek. Water in Steamboat Creek originates from Steamboat Ditch and Washoe Lake. Creek waters at the mouth contain irrigation water, urban runoff and Reno-Sparks JWPCP effluent. The lower reach of Steamboat Creek from the town of Steamboat to the downstream segment affected by the JWPCP has been designated Class D, indicating fish spawning activities are unlikely to occur due to stream pollution levels (W-1). Water flowing from Steamboat Creek exhibits advanced eutrophication.

No known sampling information on the aquatic biota of lower Steamboat Creek is available (D-4). Since it is eutrophic, this reach of the creek probably contains summer algal blooms with portions of the substrate covered by dense algal mats. Benthic macroinvertebrates during these bloom periods are undoubtedly dominated by pollution-tolerant species. Fishes expected to occur during periods of maximum dissolved oxygen and favorable environmental conditions are green sunfish (Lepomis cyanellus), largemouth black bass, bluegill (Lepomis macrochirus), and the more ubiquitous minnows and suckers (S-20). Information on fish stocking or angling in lower Steamboat Creek was also not available at the time of writing.

- Spanish Springs Valley

The only significant aquatic habitat in Spanish Springs Valley is the series of central ponds fed principally by water from Orr Ditch. No known sampling information on the aquatic biota of these ponds is available (F-9). Green sunfish, largemouth black bass, bluegill, and black bullhead may occur in one or more of the ponds (S-20,F-9). No information on fish stocking is available. Little angling occurs because the ponds are not open to the public (F-10).

- Pyramid Lake

Plankton

Pyramid Lake is eutrophic, slightly saline, alkaline, relatively deep, and biologically very productive (L-4, K-5). Recent research indicated that the epilimnion, extending to a maximum depth of 20 meters, was the zone of greatest plankton productivity (K-5). Diaptomus sicilis, a copepod, was the dominant zooplankter in both vertical and horizontal distribution with the exception of a cladoceran, Maina hutchinsoni, during July and August of 1974. Ceriodaphnia quadrangula was second in order of dominance during the summer. Other zooplankter species in the lake are Cyclops vernalis, Daphnia schodeleri, Alona costata, and Diaphanosoma leuchtenbergianum (K-5). A very substantial algal bloom of Nodularia spumigena, a blue-green alga, occurs just prior to or during the peaks of summer lake stratification. The zooplankton populations tend to peak just prior to or during the algal bloom.

Algae in the lake are numerous and range from cold to hot water dwellers (K-5). Species identified in Pyramid Lake are listed in Appendix 3. Nodularia spumigena was the dominant algal species due to its annual summer bloom. During peak bloom, the algal mat can reach a thickness of 10 cm on the lake surface.

Benthic Macroinvertebrates

Little information is available on the lakes's benthic macroinvertebrates and factors affecting their substrate environment. It is apparent that a very ample food base is available to support benthos. However,

insects are relatively scarce (L-4). No specific discussion of macroinvertebrate species interrelationships, relative importance, or similar information for Pyramid Lake is available. A list of known lake invertebrates appears in Appendix 3. Amphipods are known to be an important food source of young trout in the lake (I-1).

Fish

Fish growth is very rapid in the lake due to the lake's warm temperature, plentiful nutrient supply, and abundant food (L-4). The original population of Lahontan cutthroat in the lake produced the largest specimens on record, before its eventual extinction. Since its extirpation (about 1940), the original Lahontan cutthroat trout population has been replaced and maintained through periodic stocking. It contributes significantly to the current lake fishery (I-1). With the exception of those species that require cold water temperatures, Lahontan drainage fish species today are abundant. A list of fish species known to occur in the lake is included in Appendix 3.

Historically, the adult Cui-ui population was thought to inhabit deep water except during spring spawning (L-4). However, it is unknown what the time and spacial distribution of the Cui-ui in the lake really is ("A"). When up-river spawning migration was still possible, this fish was known to migrate as far as the Wadsworth area. Since 1973, approximately 7.6 million Cui-ui fry have been stocked.

The tui chub serves as an important buffer and forage species for trout and the Sacramento perch (R-21). The population of Tahoe sucker also provides a significant amount of forage for trout (I-1).

The lake supports a trophy fish fishery; however, it is dependent upon periodic stocking. Trout caught average 5 pounds (I-1). The accelerated stocking programs now enacted plus proposed spawning runs made possible by the new Pyramid Lake Fishway should insure the continued success of the lake's fishery.

Pyramid Lake is about 70 feet lower than it was in 1905. It is approximately 337 feet at its deepest point, has a surface area of about 110,000 acres, and a volume of

about 21,000,000 acre-feet (I-1). The decline of the lake level for the past century is discussed in Chapter 3. If the outcome of current litigation on Truckee River water rights favors increased annual water allotment to Pyramid Lake, the lake's fishery, particularly the Lahontan cutthroat trout and the Cui-ui lakesucker, will be further assured of recovery.

Rare and Endangered Species

The concern for rare, endangered and threatened species has a broader significance than an interest in preserving individual forms from extinction. The status of many threatened forms may be used as a gauge of the reduction or deterioration of habitats and thereby reflects the health of the ecological systems with which these habitats and species are associated. A list of U. S. endangered species reported from the study area is presented in Table 2-P.

Within the Lower Truckee River system, Spanish Springs and Pyramid Lake regions, there are no known rare or endangered species of plants.

Endangered bird species known to occur within the study area or with a recent history of occurrence are the peregrine falcon (Falco peregrinus anatum) and the southern bald eagle (Haliaeetus leucocephalus leucocephalus). Both forms are listed as endangered by the U. S. Department of Interior (I-2). Both endangered raptors are predatory birds that may utilize portions of the Truckee Meadows and Spanish Springs area for hunting. The pigeon hawk (Merlin hawk - Falco columbarius) and ferruginous hawk (Bueteo regalis) are both designated as rare and endangered in Nevada. These species are also predators on rodents, birds and insects. Bird species which are considered as rare within the study area include the Osprey (Pandion haliaetus) which occasionally winters in Truckee Meadows, white-faced ibis (Plegadis chihi) which visits large water bodies in the Truckee Meadows area during migration, the snowy plover (Charadrius alexandrinus) which is an uncommon summer resident, long-billed curlew (Numenius americanus) and burrowing owl (Speotyto cunicularia) which are known to nest in the study area, and the yellow-billed cuckoo (Coccyzus americanus) (F-3).

The spotted bat (Euderma maculata) and the Sierra red fox (Vulpes vulpes necator) are rare mammals which are occasional visitors in the area (F-3).

TABLE 2-P

ENDANGERED SPECIES -- LOWER TRUCKEE RIVER BASIN[a]

Species			
Common Name	Scientific Name	Distribution	Remarks
Southern bald eagle	*Haliaeetus leucocephalus leucocephalus*	Ranges over most of California nesting in coastal and interior mountains.	Decline appears to be due to shooting removal of nesting trees, human encroachment, environmental pollution (e.g., pesticides) resulting in reduced reproductive success.
American peregrine falcon	*Falco peregrinus anatum*	Breeding populations only in California. Reported in mountain areas, along coast and on channel islands.	Mortality currently exceeds natality and in 1970, 10 birds known in California. Decline due to pesticides and illegal taking by falconers.
Lahontan cutthroat trout	*Salmo clarkii henshawi*	Lahontan drainage system of western Nevada. Pyramid, Walker and Summit Lakes; Catnip Reservoir, Truckee, Carson and Walker Rivers.	Important sport fish adapted to highly alkaline waters. Original population in Pyramid Lake and Lake Tahoe extinct. Now stocked in Pyramid Lake as game fish. Decline due to inability of trout to migrate through obstructed delta at mouth of the Truckee to spawning grounds upstream. Attempts are underway to correct this condition.
Cui-ui	*Chasmistes cuju*	Pyramid Lake, Nevada. Formerly extended into lower Truckeee River, Nevada.	The Cui-ui is utilized as a food source by the Pyramid Indians.

NOTES: (a) Source of designation - U. S. Department of Interior, Fish and Wildlife Services, May 1974.

Source: (I-1)

Two species of fish, the Lahontan cutthroat trout (Salmo clarkii henshawi) and the Cui-ui (Chamistes cuju) are listed as endangered. Both species occur in Pyramid Lake and the Truckee River.

AIR QUALITY AND NOISE

Air Quality

- Evaluation of Severity of Air Quality Problems

Basis for Standards

The Clean Air Act of 1970 requires the Administrator of the USEPA to issue air quality criteria. In addition, it requires these criteria to accurately reflect the latest scientific knowledge of the effects on public health or welfare of ambient pollutants. Air pollutant criteria must include information on:

1) those variables (including atmospheric conditions) which may alter the effects of an air pollutant on public health or welfare;

2) the types of air pollutants which, when present in the atmosphere, may interact with a pollutant to produce an adverse effect on public health or welfare; and

3) any known or anticipated adverse effects on welfare (E-38).

Air quality criteria are not viewed as normative statements, i.e., they are not in themselves policy judgments which express value choices as to how pure or polluted the atmosphere should be (F-13). Rather, their purpose is to guard the health and welfare of the public.

Air quality criteria have been issued for the following pollutants: sulfur dioxide, carbon monoxide, suspended particulates, oxidants, oxides of nitrogen and hydrocarbons. Based on these criteria and available pollution control techniques, the EPA has published primary air quality standards for each of these pollutants. Unlike air quality criteria, which are predictive or descriptive, air quality standards are prescriptive - they prescribe pollutant levels that cannot legally be exceeded during a specific time period in a specific geographic area.

Air quality standards are of two types, primary and secondary. Primary standards are those which, in the judgment of the EPA Administrator, are necessary to protect the public health. Secondary standards protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air (F-13). National primary and secondary air quality standards are listed in Table 2-Q. Similar standards have been adopted by the State of Nevada, Washoe County, and the Cities of Reno and Sparks, and are presented in Appendix 1.

Air Quality Data - Reno Area

Air quality data monitored by the Washoe County District Health Department (WCDHD) which describes average and instantaneous peak pollutant concentrations in Reno and vicinity during a continuous period from 1972 through 1975 is presented in Figures 2-10 through 2-14. The data collected by the WCDHD is sent to EPA Region IX for their review and then forwarded to the National Air Data Bank (NADB) for reduction and analysis. The data is graphically compared with National Primary Air Quality Standards and illustrates the seasonal variability of some of the pollutants. The locations of WCDHD monitoring sites are illustrated in Figure 2-15. As shown on this map, suspended particulate concentrations are monitored at numerous locations in Reno/Sparks and vicinity, but WCDHD monitors all other pollutants (carbon monoxide, nitrogen dioxide, oxidants, and hydrocarbons) continuously only at the downtown site (Evans and Plaza Streets). Sulfur dioxide concentrations are measured every sixth day at the downtown site, and data indicates ambient levels are close to zero (W-13).

During the period August, 1974 through August, 1975, the State of Nevada Department of Highways sponsored the Truckee Meadows Basin Air Quality Study (TMBAQS) to assess impacts on air quality due to proposed highway projects (A-4). The study provides a greatly expanded data base for characterization of gaseous air pollutants in the entire Reno area, rather than at a single downtown location. Two station networks, one established to measure mesoscale variations of all pollutants and the other to evaluate the microscale variation of a single pollutant (carbon monoxide), were implemented

TABLE 2-Q

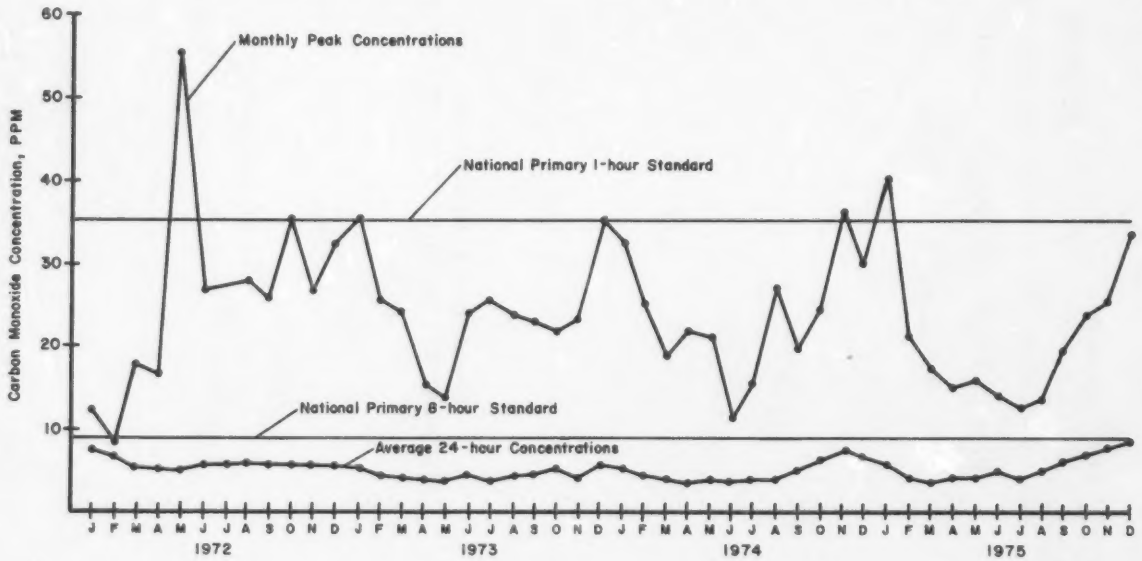
FEDERAL AIR QUALITY STANDARDS[b]

	SO_2	Particulate Matter	CO	Oxidant	NO_x	HC
		(ppm unless otherwise noted)				
		Primary Standards				
Annual						
(arith. mean)	0.03				0.05	
(geom. mean)		75[a]				
24-hr. max	0.14[c]	260[a][c]				
8-hr. max			9[c]			
3-hr. max						0.24[c]
1-hr. max			35[c]	0.08[c]		
		Secondary Standards (where different from primary)				
Annual						
(arith. mean)						
(geom. mean)		60[a]				
24-hr. max		150[a][c]				
3-hr. max	0.5[c]					

NOTES: [a] ug/m^3
[b] As published by USEPA, April 30, 1971
[c] Not to be exceeded more than once per year

Source: (F-15)

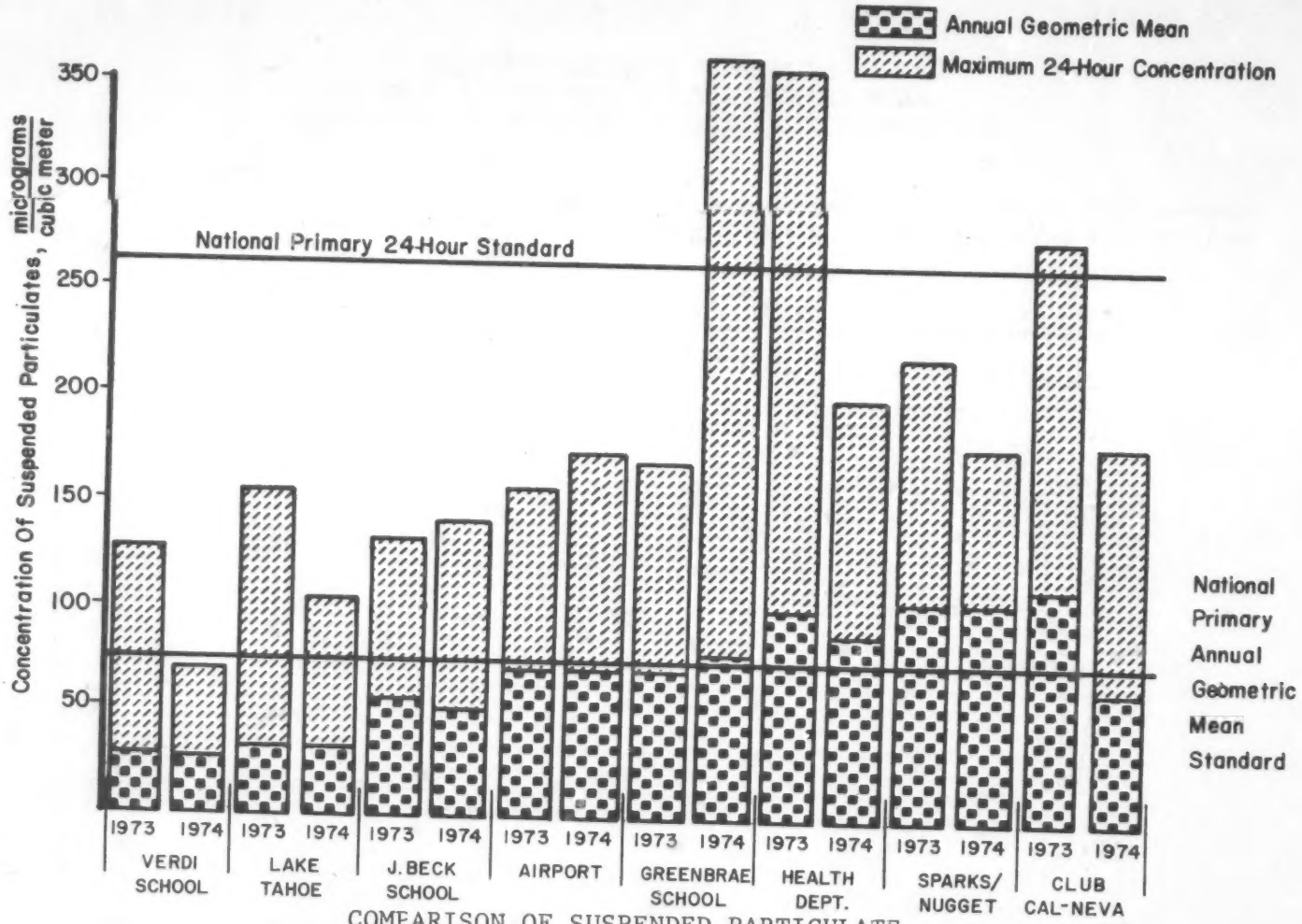
NOTE: Monthly peak concentrations should not be interpreted as violations of National 1-Hour Standard, since peak concentrations do not persist as long as 1 hour.



COMPARISON OF CARBON MONOXIDE CONCENTRATIONS
AT RENO (EVANS AND PLAZA STREETS) WITH
NATIONAL PRIMARY STANDARDS

Source: (H-9, H-18)

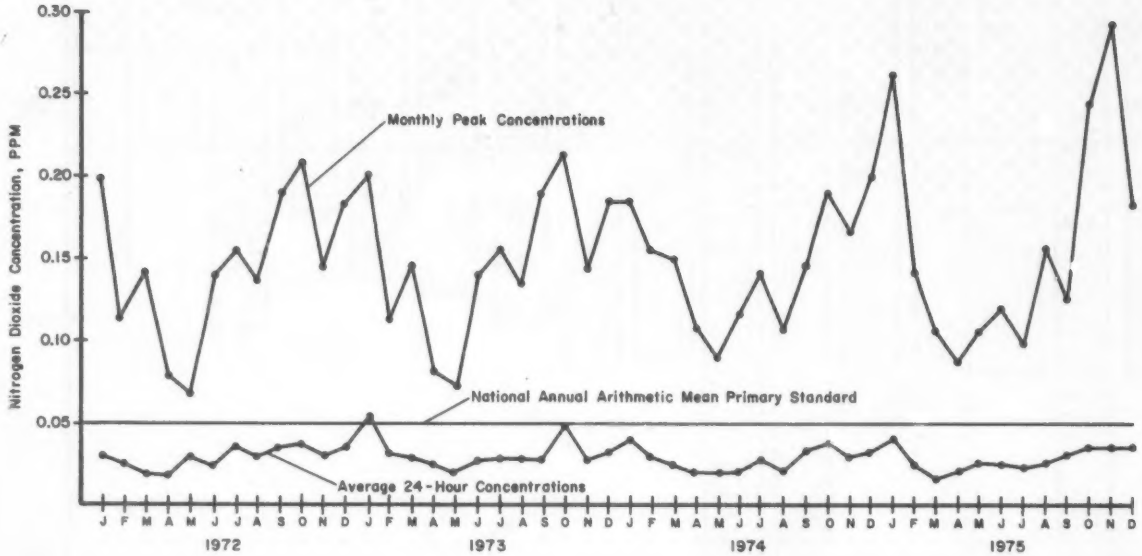
Figure 2-10



COMPARISON OF SUSPENDED PARTICULATE CONCENTRATIONS WITH NATIONAL PRIMARY STANDARDS (WASHOE COUNTY DISTRICT HEALTH DEPARTMENT MONITORING STATIONS)

Source: (H-9)

Figure 2-11

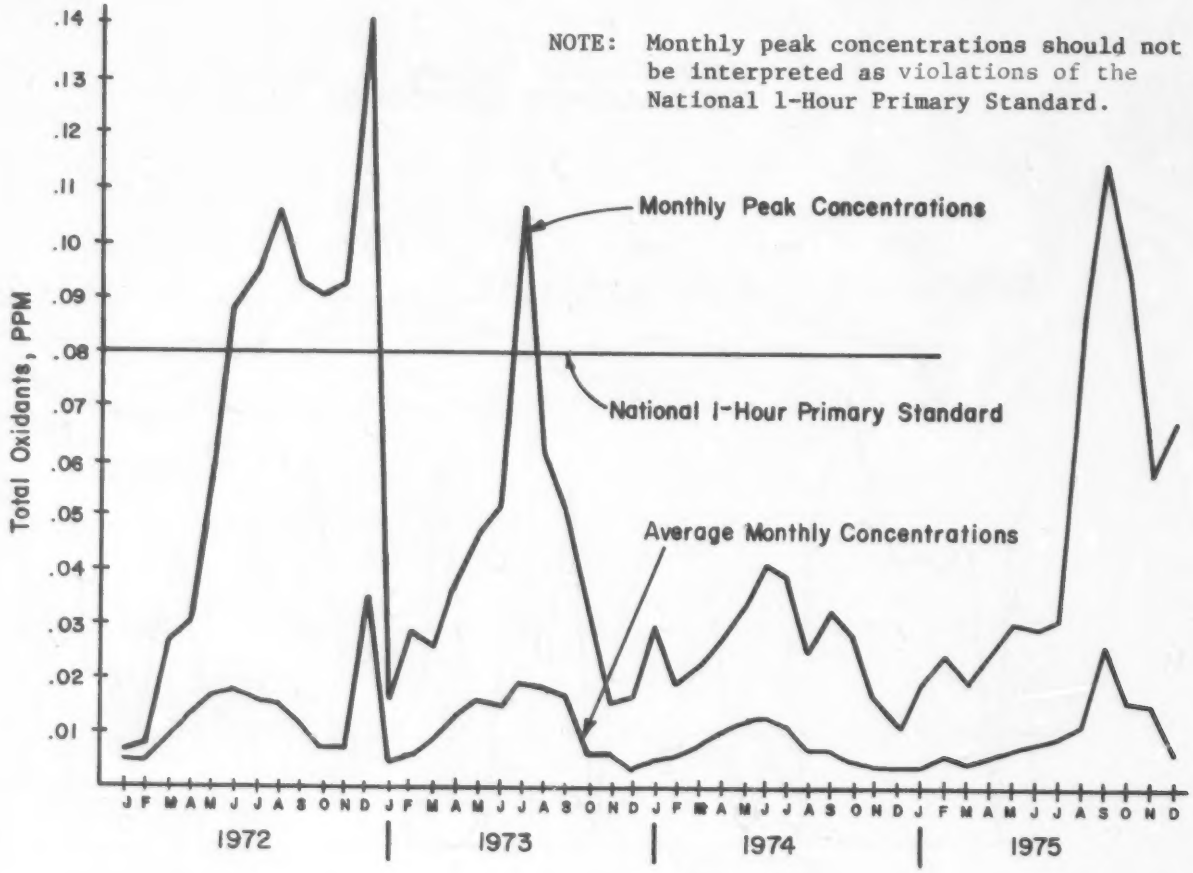


NOTE: Highest 24-hour concentrations during each month should not be interpreted as violations of the National Annual Arithmetic Mean Primary Standard. No violations of this standard occurred during the period 1972-1975.

COMPARISON OF NITROGEN DIOXIDE CONCENTRATIONS
AT RENO (EVANS AND PLAZA STREETS) WITH
NATIONAL PRIMARY STANDARDS

Source: (H-9, H-18)

Figure 2-12

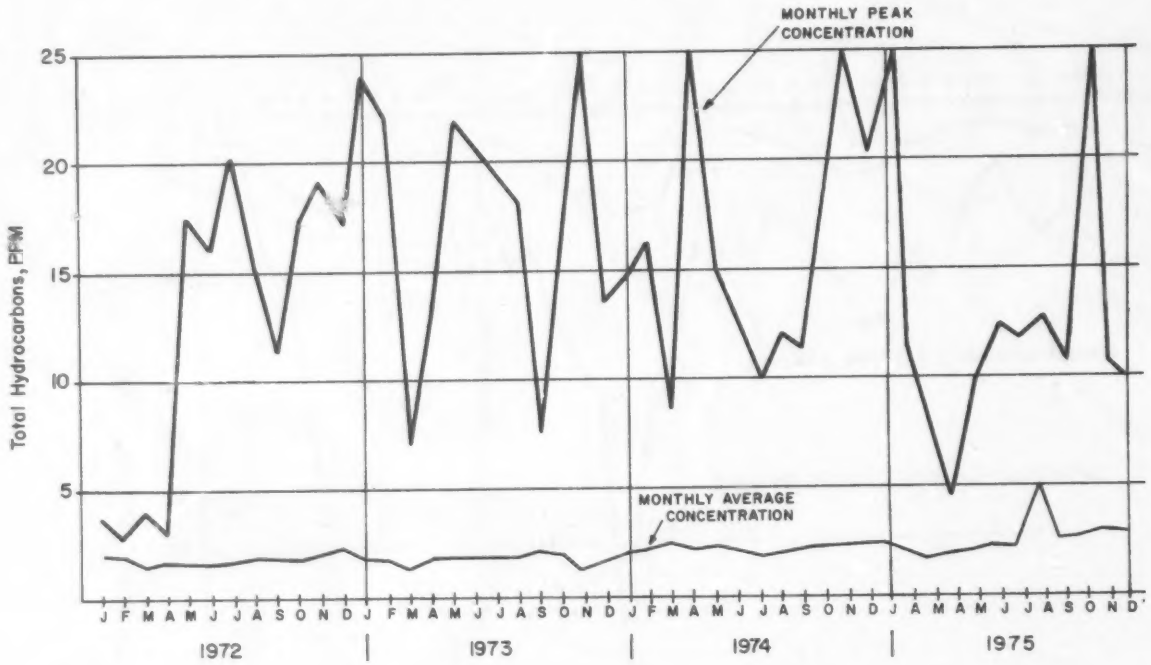


COMPARISON OF TOTAL OXIDANT CONCENTRATIONS
AT RENO (EVANS AND PLAZA STREETS) WITH
NATIONAL PRIMARY STANDARDS

Source: (H-9, H-18)

Figure 2-13

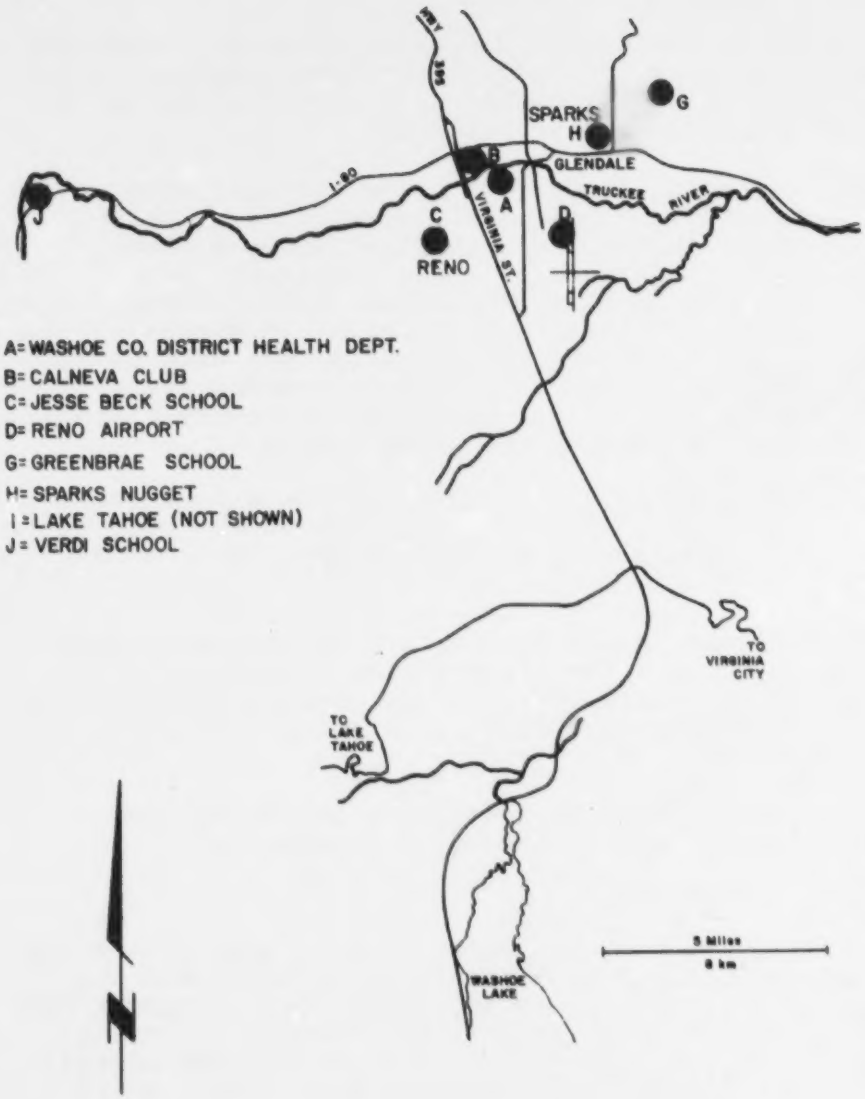
NOTE: Monthly peak and average concentrations are not comparable with the National Primary 3-Hour Standard.



TOTAL HYDROCARBON CONCENTRATIONS
AT RENO (EVANS AND PLAZA STREETS)

Source: (H-9, H-18)

Figure 2-14



AIR QUALITY MONITORING SITES
WASHOE COUNTY DISTRICT HEALTH DEPARTMENT

Source: (P-8)

Figure 2-15

during the TMBAQS. Locations of mesocale and microscale network monitoring sites are illustrated in Figures 2-16 and 2-17 (A-4).

In addition to the normal operation of WCDHD's downtown monitoring site and several particulate sampling sites, air quality monitoring in the Reno vicinity during the study period included the following:

1) Carbon monoxide (CO) concentrations were monitored continuously year-round at three sites (M2, M5, M8) and continuous measurements were made at three additional sites (M1, M4, M7) from November, 1974 through February, 1975. In addition, 18 microscale sites (B1 through B18) were used to gather 24 sequential 1-hour samples every third day during the winter and every sixth day the rest of the study period.

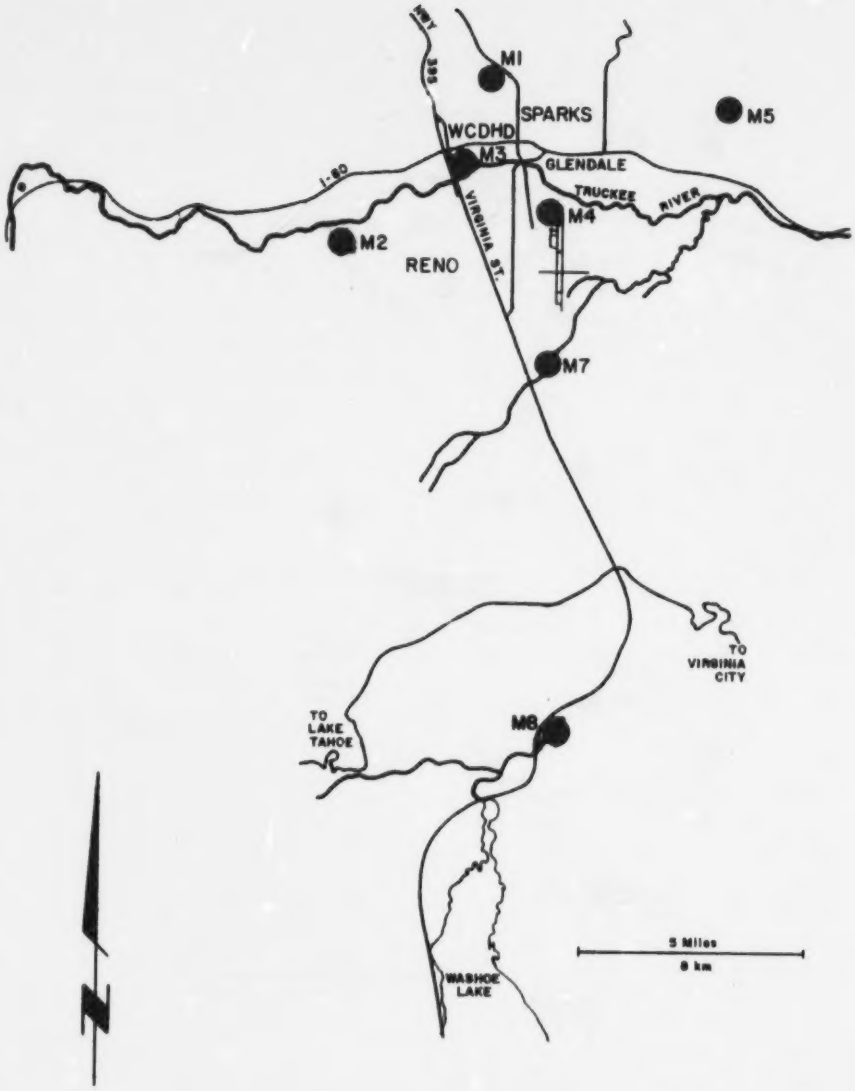
2) Hydrocarbon and oxidant concentrations were monitored continuously at two sites (M2, M5) and, during August-October, 1974, at a third site (M7).

3) Nitrogen oxide concentrations were monitored throughout the study period continuously at two sites (M2, M5) and, during August, 1974-February, 1975, at a third site (M7) (A-4).

Results of the TMBAQS are discussed in the section entitled "Comparison of Data with Standards."

Monitoring Techniques

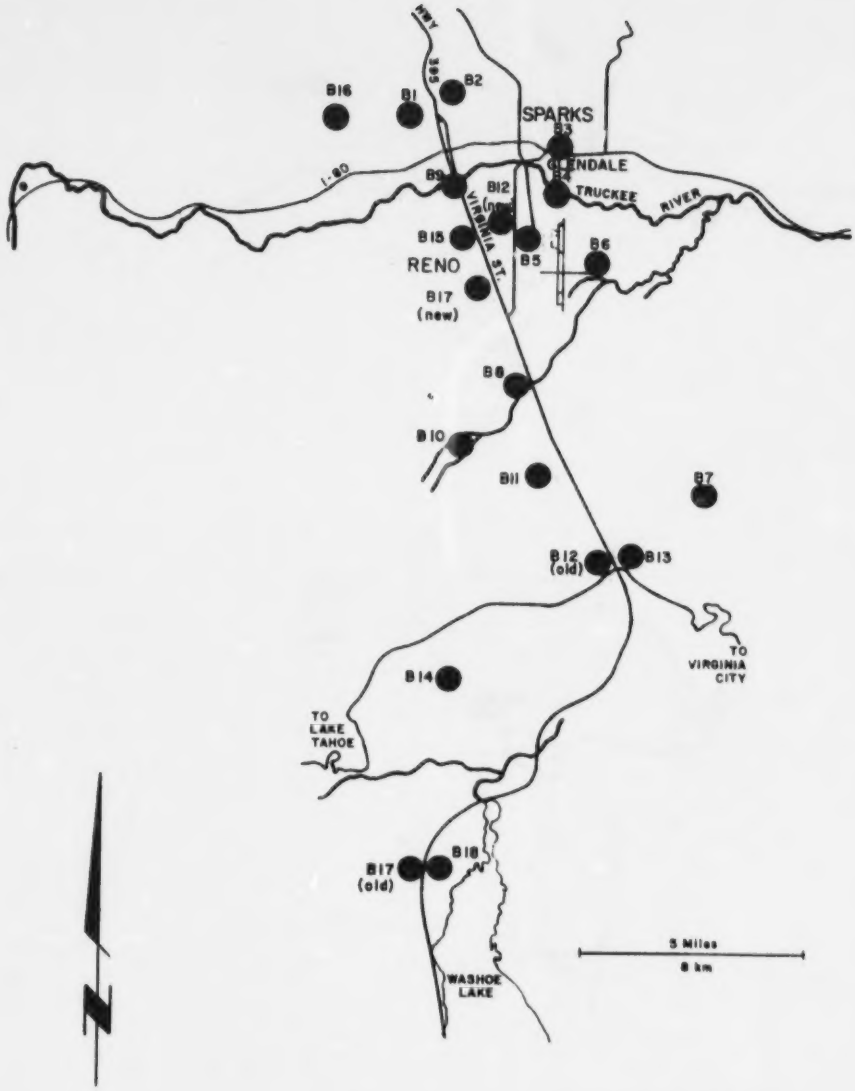
The specific types of equipment used to measure ambient air concentrations of pollutants of interest and the methods of calibrating and operating this equipment are important because they affect the accuracy and reliability of the data generated. The EPA has designated certain reference methods or their equivalents which should be used in generating air quality data. (An exception is nitrogen dioxide, for which an acceptable reference method has not yet been developed). All data presented in this EIS was gathered using EPA-approved reference methods or their equivalents (B-25). Monitoring techniques used by WCDHD to generate data are presented in Table 2-R.



MESOSCALE AIR QUALITY AND
METEOROLOGY MONITORING SITES
TRUCKEE MEADOWS BASIN AIR QUALITY STUDY

Source: (A-4)

Figure 2-16



LOCATION OF MICROSCALE CO MEASUREMENT
SITES B1 THROUGH B18
TRUCKEE MEADOWS BASIN AIR QUALITY STUDY

Source: (A-4)

Figure 2-17

TABLE 2-Ra

MONITORING METHODOLOGY - WASHOE COUNTY HEALTH DEPARTMENT

Pollutant/ Monitoring Site	Location of Monitoring Site	Description of Monitoring Site	Monitoring Technique	Description of Monitoring Technique
1. Total Suspended Particulates [a]				
Lake Tahoe	958-1/2 Lakeshore Blvd.	On roof of pump station, 20 feet above ground, in a forested area, 100 yards from lake.	Hi-Vol gravimetric	A large volume of air is passed through a filter for 24 hours. Particulate matter collected on the filter is dried and weighed.
Verdi School (J)	Old Dog Valley Road	Roof of school, 20 feet above ground, rural area.	Hi-Vol gravimetric	
J. Beck School (C)	1900 Sharon Way, Reno	On roof of school, 20 feet above ground, residential area.	Hi-Vol gravimetric	
Airport (D)	2601 E. Plumb Lane, Reno	On roof of Weather Service Building, 20 feet above ground.	Hi-Vol gravimetric	
Greenbrae School (G)	4th & "O" Streets, Sparks	On roof of school, 20 feet above ground, residential area.	Hi-Vol gravimetric	
Health Department (A)	10 Kirman Avenue, Reno	On roof of Health Building, 20 feet above ground, commercial-residential area.	Hi-Vol gravimetric	
Sparks Nuggett (H)	1125 "B" Street, Sparks	On roof of Casino, 25 feet above ground, commercial area.	Hi-Vol gravimetric	
Club Cal-Neva (B)	2nd & Center Streets, Reno	On roof of casino, 25 feet above ground, commercial area.	Hi-Vol gravimetric	
2. Oxidants				
Trailer	Evans and Plaza Streets, Reno	Heated, air-conditioned trailer on parking lot in downtown commercial area. Air intake 10 feet above ground.	Coulometric	Air containing oxidants is reacted with a solution to produce an electric change, which is measured.

TABLE 2-Rb

MONITORING METHODOLOGY - WASHOE COUNTY HEALTH DEPARTMENT
(continued)

Pollutant/ Monitoring Site	Location of Monitoring Site	Description of Monitoring Site	Monitoring Technique	Description of Monitoring Technique
3. Hydrocarbons				
Trailer	Evans & Plaza Streets, Reno	Heated, air-conditioned trailer on parking lot in downtown commercial area. Air intake 10 feet above ground.	Flame ionization	Air containing hydrocarbons is combined with hydrogen and burned, forming ions. The ion current generated is proportional to the rate at which hydrocarbon atoms are introduced into the flame.
4. Nitrogen Dioxide				
Trailer	Evans & Page Streets, Reno	Heated, air-conditioned trailer on parking lot in downtown commercial area. Air intake 10 feet above ground.	Coulometric	Employs electro chemical sensor.
5. Carbon Monoxide				
Trailer	Evans & Page Streets, Reno	Heated, air-conditioned trailer on parking lot in downtown commercial area. Air intake 10 feet above ground.	Non-dispersive infra-red	The amount of carbon monoxide in an air stream is measured by the amount of absorption of infra-red light.

NOTES: [a] Letters in parentheses indicate site number in Figure 2-15.

A summary of monitoring techniques used during the TMBAQS is contained in Table 2-S. EPA reference techniques were used at all macroscale stations, and a review of the techniques and site locations used in the study by EPA Region IX indicated that the data gathered appears to be valid (G-8).

Comparative tests made at WCDHD and TMBAQS trailers parked side-by-side in downtown Reno were conducted by the EPA's Las Vegas Environmental Monitoring and Surveillance Laboratory, August 18 to 19, 1975. Test results suggested that WCDHD ozone measurements were on the low side. Differences in the data generated could be attributable to different monitoring techniques used or technical difficulties associated with calibration equipment used by WCDHD (A-5).

Comparison of Data with Standards

Suspended Particulate Matter - Suspended particulate data collected at eight sites by the WCDHD in the Reno vicinity from 1973 to 1974 is presented in Figure 2-11. As shown in Figure 2-11, the National Primary Annual Geometric Mean Standard of 75 $\mu g/m^3$ was exceeded at three of the eight monitoring sites in both 1973 and 1974. The National Primary 24-hour Standard of 260 $\mu g/m^3$ was exceeded at the Health Department monitoring site on at least 1 day in both February 1973 (high of 358 $\mu g/m^3$) and December 1973 (high of 305 $\mu g/m^3$), which represents a violation of a standard not to be exceeded more than once per year. The Club Cal-Neva Station exceeded 260 $\mu g/m^3$ on at least 1 day in December, 1973 (274 $\mu g/m^3$). The Greenbrae School Station exceeded 260 $\mu g/m^3$ on 1 day in October, 1974 (366 $\mu g/m^3$).

During the TMBAQS, (August, 1974 to August, 1975), ten WCDHD sites monitored particulates. Their locations are shown in Figure 2-16. Federal Primary Standards for annual and 24-hour averages were exceeded. Two sites, the Washoe County Health Department (A) and the Sparks Station (H) exceeded the Federal Primary Standard of 75 $\mu g/m^3$ for an annual geometric mean. Sparks (H) reported 89.9 $\mu g/m^3$ for the period from October, 1974 through September, 1975. The Secondary Standard of 60 $\mu g/m^3$ was exceeded at the Reno International Airport (D) (64.1 $\mu g/m^3$). The Primary 24-Hour Standard of 260 $\mu g/m^3$ was exceeded twice, once at Sparks (H) (297.6 $\mu g/m^3$ on March 1, 1975), and once at the Greenbrae

TABLE 2-S

MONITORING METHODOLOGY -
TRUCKEE MEADOWS BASIN AIR QUALITY STUDY

Pollutants Measured	Sites	Monitoring Technique
1. Total hydrocarbons, methane, carbon monoxide	M_2, M_5	Flame ionization
2. Total hydrocarbons, methane	M_7	Flame ionization
3. Carbon monoxide	M_1, M_4, M_7, M_8	Non-dispersive infra-red
4. Carbon monoxide	Microscale	Dual isotope fluorescent
5. Nitrogen oxides	M_2, M_5, M_7	Chemiluminescence with ozone
6. Photochemical oxidants	M_2, M_5, M_7	Chemiluminescence with ethylene

School (G) (366.3 $\mu g/m^3$ on October 20, 1974). Violations of the Secondary 24-Hour Standard of 150 $\mu g/m^3$ were reported at seven of the ten sites, most frequently at the Sparks Station (H) (A-4).

The data indicates that levels of suspended particulates are quite variable over the Reno vicinity, ranging from very low values at Lake Tahoe and Verdi to occasional very high values which exceed air quality standards in the urban area.

Projections made by USEPA Region IX indicate that violations of the annual geometric mean air quality standard for suspended particulates may be expected to continue to occur (F-14). Similarly, the TMBAQS concluded that attainment of federal NAAQS for suspended particulate concentrations would not occur during the period 1975 to 1995 (A-4). This situation has necessitated designation of that portion of Washoe County which lies south of the township line common to T.21N. and T.22N., Mount Diablo Base and Meridian, as an Air Quality Maintenance Area (E-31) for suspended particulates. The location of this region is shown in Figure 2-18. The purpose of this designation is to identify those areas which, due to current air quality and/or projected growth rate, may potentially exceed any National Ambient Air Quality Standards (NAAQS) in the next 10 years. If an area is so identified, the state must "submit a plan to prevent any national standards from being exceeded over the 10-year period from the date of plan submittal. Such plans shall include, as necessary, control strategy revisions and/or other measures to ensure that projected growth and development will be compatible with maintenance of the national standards through such a 10-year period" (E-31).

Carbon Monoxide - Carbon monoxide concentrations measured at the WCDHD monitoring site in downtown Reno are presented in Figure 2-10. The NADB reported that the 8-hour average carbon monoxide standard of 9 ppm was violated in downtown Reno 147 times in 1972 (5 percent of all validated 8-hour periods) and 260 times in 1973 (3 percent of validated 8-hour periods). The highest 8-hour average concentrations during those years were 18.07 and 18.33 ppm, respectively (N-6).

LOCATION OF NORTHWEST NEVADA
AIR QUALITY MAINTENANCE AREA

Source: (E-31)

Figure 2-18

The TMBAQS illustrates the contrast between carbon monoxide concentrations in downtown Reno and other portions of the city and surroundings. During the August, 1974 to March, 1975 portion of the study period, 8-hour average concentrations of the WCDHD site in downtown Reno exceeded the 9 ppm 8-hour standard on 21 percent of the days, with the highest 8-hour average 16 ppm (A-4). The 8-hour standards were also exceeded during the study period at four microscale stations (B3, B4, B9 and B15), all locations at or near downtown Reno (A-4). No violations of the 8-hour standard occurred at any of the other monitoring sites located outside the downtown area during the entire study period. Only one station, B15 in downtown Reno, exceeded the 1-hour standard (35 ppm). Maximum 1-hour concentrations ranged from 26 ppm at the WCDHD site in downtown Reno, to 17 ppm at site M2 and 6 ppm at Site M5 (A-4). Typical carbon monoxide averages during the study were near background (0.5 to 1.0 ppm) at all sites, except downtown, where the average ranged from 3.5 to 6.5 ppm depending on the season (A-4).

The highest carbon monoxide concentrations were generally observed in the winter months. During the TMBAQS period, 73 percent of all 8-hour carbon monoxide violations at the WCDHD downtown monitoring site occurred during the winter. Typically, peak concentrations occur during the morning and evening rush hours. Projections made under contract to the State of Nevada Department of Highways indicate that carbon monoxide standards will not be attained until 1981 (A-4). Projections made recently by USEPA Region IX also predict future violations of the 8-hour NAAQS for carbon monoxide (F-14).

Nitrogen Dioxide - Nitrogen dioxide concentrations measured at the Washoe County District Health Department's monitoring site in downtown Reno are presented in Figure 2-12. As shown, monthly mean concentrations are highest during winter and lowest during summer. The National Annual Arithmetic Mean Standard was not violated during 1972, 1973, 1974 or 1975 in downtown Reno. Neither was the standard exceeded at any time at any location during the Nevada Highway Department Study. The highest annual average, at Site M2, was 0.03 ppm (A-4).

Photochemical Oxidants - Photochemical oxidants are produced through reactions involving hydrocarbons, nitrogen oxide, sulfur dioxide, and oxygen in the presence of sunlight. Sulfur dioxide plays a relatively minor role in the reactions, and its presence is not essential to oxidant formation. The reactions take 1 hour or more to complete, during which time transport and dilution may occur (E-39). The rates of photochemical oxidation in the Reno area tend to lessen during the winter due to decreased solar radiation.

Total oxidant concentrations measured at the WCDHD monitoring site in downtown Reno are presented in Figure 2-13. As shown, monthly and 24-hour maximum concentrations are highly variable, with summer concentrations considerably exceeding winter concentrations in most normal situations.

Washoe County has reported its data in terms of monthly instantaneous peak values rather than 1-hour average maximum concentrations. Although instantaneous peak concentrations of photochemical oxidants above the NAAQS 1-hour standard (0.08 ppm) have occurred throughout the period 1972 through 1975, they apparently do not persist for as long as 1 hour, and the NADB reports no violations of standards for the pollutant photochemical oxidants in downtown Reno during the period 1973 through 1974 (N-6).

The Truckee Meadows Basin Air Quality Study indicates that photochemical oxidant concentrations across the city exhibit a trend contrary to that shown by carbon monoxide. Whereas carbon monoxide concentrations are highest at the downtown site and lower in surrounding portions of Reno, photochemical oxidant concentrations are highest at Site M2, located 8 miles west of the downtown site (A-4). During the study period, the 1-hour standard was exceeded 148, 12 and 27 times, at Sites M2, M5 and M7, respectively (A-4). The highest 1-hour average concentrations at these three sites were 0.165, 0.100, and 0.110 ppm, respectively. The median hourly concentration was 0.036 ppm at Site M2 and 0.022 ppm at M5; data was not available for Site M7 (A-4). During the study period, the highest frequency of violations occurred during the summer months, but concentrations above the standard occur during all seasons of the year. Concentrations tend to be lowest in the hours preceding dawn and increase after sunrise to higher levels

by late morning (A-4). Projections made under contract to the Nevada Highway Department indicate federal oxidant standards at Reno will not be attained during the period 1975 to 1995 (A-4). At this time, the area has not been designated an AQMA for this pollutant.

Hydrocarbons - Total hydrocarbon concentrations measured at the WCDHD monitoring site in downtown Reno are presented in Figure 2-14. This data cannot be compared to national standards since they are concerned only with the non-methane reactive hydrocarbon fraction of the total hydrocarbon concentration. During the Nevada Highway Department air quality study, violations of the 3-hour non-methane hydrocarbon standard (0.24 ppm) were reported quite often at all sites, with a reported frequency of violation approaching 100 percent in all months except October at Site M2. The highest 3-hour average, 7 ppm, occurred in July, 1975 at Site M5 (A-4).

- Nature of the Existing Air Quality Problem

Sources of Air Pollutants

Primary sources of carbon monoxide, hydrocarbons, sulfur oxides, and nitrogen oxides are presented in Table 2-T. This data was obtained from a 1973 emissions inventory of pollutant sources in all incorporated and unincorporated portions of Washoe County, and also includes a fraction (1/3) of emissions emanating from three sources which border, but are not actually located within, Washoe County (H-11). Gasoline motor vehicles are the primary source of carbon monoxide and hydrocarbons in the Reno area. Automobiles, trucks, buses, and trains are responsible for the majority of emissions of nitrogen oxides.

Most sulfur oxides emitted result from the combustion of oil used for residential and commercial heating and power generation. The total amount of sulfur oxides emitted is very small.

The emissions inventory revealed no known primary sources of photochemical oxidants. This pollutant is formed through chemical transformations involving hydrocarbons, nitric oxides, and oxygen in the presence of sunlight, but photochemical oxidants are not directly emitted into the atmosphere. The TMBAQS estimates that 50 percent of all ozone precursors are presently generated by

TABLE 2-T

SOURCES OF POLLUTANTS EMITTED
IN WASHOE COUNTY - 1973

Carbon Monoxide Sources	Tons	Percent of Total
Gasoline Motor Vehicles	125,931	93.8
Open Burning	3,728	2.8
Diesel Trucks, Buses and Trains	2,085	1.6
Aircraft	1,681	1.3
All Others	870	0.5
	134,295	100.0
Sources of Hydrocarbons		
Gasoline Motor Vehicles	22,676	57.4
Open Burning (estimate)	12,266	31.0
Gasoline Storage and Handling	3,626	9.2
All Others	967	2.4
	39,535	100.0
Sources of Nitrogen Oxides		
Gasoline Motor Vehicles	4,890	51.7
Diesel Trucks, Buses and Trains	3,429	36.3
All Others	1,128	12.0
	9,447	100.0
Sources of Sulfur Oxides		
Furnace Oil	1,319	51.9
Gasoline Motor Vehicles	389	15.3
Residual Oil	273	10.8
Diesel Trucks, Buses and Trains	250	9.8
Tracy Power Station	155	6.1
Open Burning (estimate)	53	2.1
All Others	100	4.0
	2,539	100.0

Source: (H-11)

automobiles (A-4). Other significant sources of ozone precursors include hydrocarbon emissions from open burning and gasoline storage and handling, and nitrogen oxide emissions from diesel truck, bus and train operations. Oxidant precursors emitted in downtown Reno may be responsible for the high frequency of violations of the photochemical oxidant standard at Station M2, 8 miles west of downtown.

Because of Reno's remote location and rugged surrounding topography, and due to the lack of significant population centers downwind of prevailing atmospheric circulation, it is unlikely that pollutants emitted in the Reno/Sparks area significantly affect the air quality of other cities in the vicinity.

Results of a recently completed study to determine the sources of suspended particulates and dust in the Reno area are presented in Table 2-U (P-8). Boundaries of the emissions inventory are illustrated in Figure 2-19 and are compared with present and proposed boundaries of the wastewater treatment plant service area. The 1975 emissions inventory includes an estimated 1,200 tons of particulate matter emitted outside the ultimate service area.

As shown in Table 2-U, the automobile is responsible for approximately two-thirds of the total emissions of particulate matter in the Reno area (P-8). While automobiles themselves emit relatively small amounts of particulate matter through their exhaust and tire wear, dust stirred up by travel along unpaved and paved roads adds significantly to the total particulate emissions in the vicinity of Reno. The "Nevada Particulate Control Study for AQMA's, Task C Report Emission Inventory Emissions Projections" cautions that

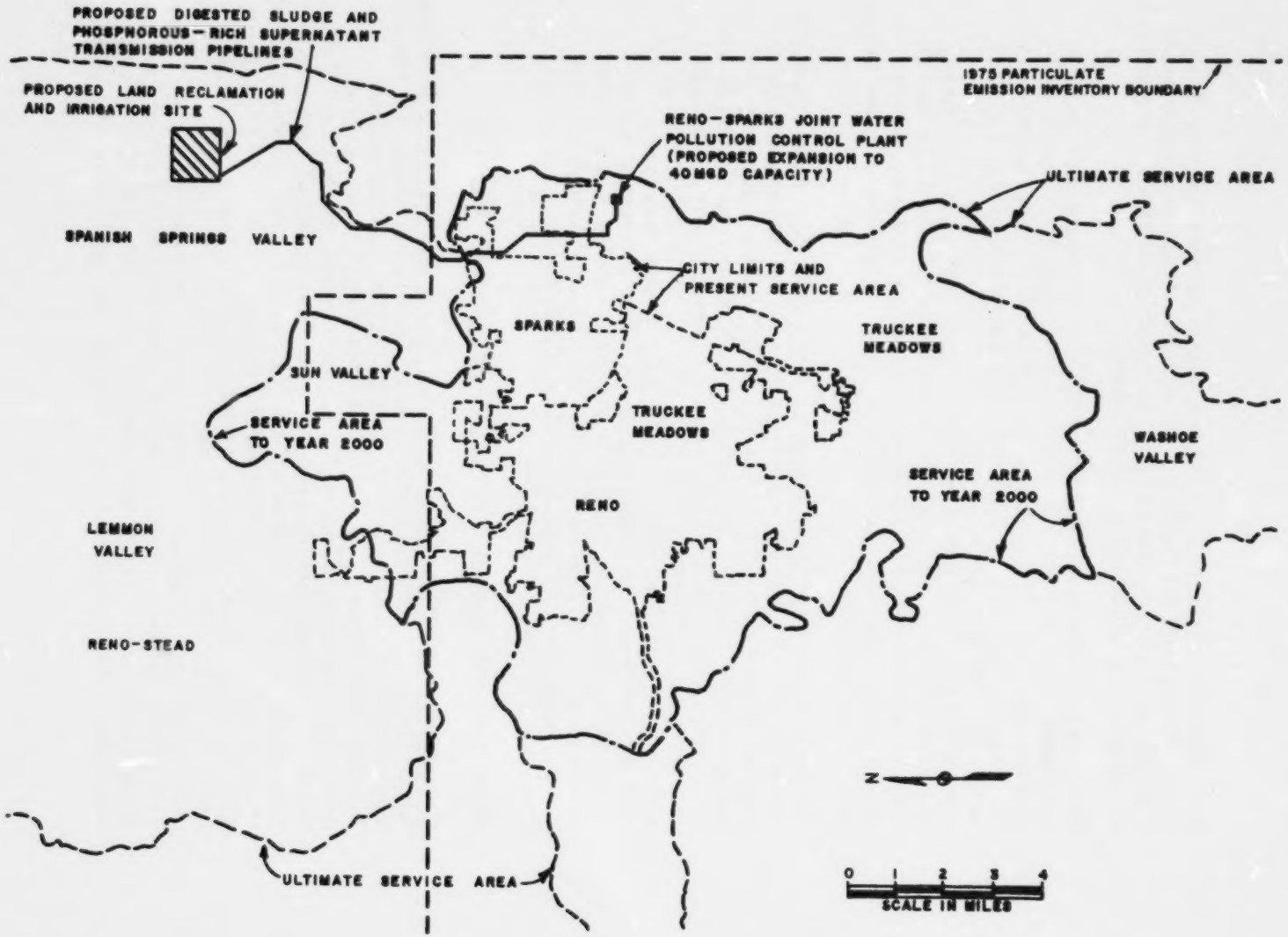
> ...care should be taken when drawing conclusions from the totals appearing in the summary tables. The emissions from a few sources, (such as unpaved roads, which represent a large percentage of the total area-wide emissions) may, in fact, have very little impact on the air quality due to the even distribution of these sources throughout the area. Sources which represent a smaller percentage of the total emissions could leave a larger impact on air quality, if they are concentrated in a smaller area. (P-8).

TABLE 2-U

SOURCES OF PARTICULATES AND DUST, 1975

	Tons/Year	Percent of Total
Automobile Operation		
Automotive exhaust	437.3	5.0
Fugitive dust from paved streets	1054.7	12.0
Fugitive dust from unpaved roads	3969.0	45.1
Street sanding	140.0	1.6
Road shoulders	2.8	0.0
Parking lots	38.8	0.4
Incineration		
Open burning	1099.5	12.5
Fuel combustion	388.2	4.4
Other Mobile Sources (aircraft, railroad, off-highway)	120.9	1.4
Construction	814.0	9.2
Sand and Gravel Pits	460.0	5.2
Miscellaneous	283.0	3.2
TOTAL	8808.2	100.0

Source: (P-8)



EMISSIONS INVENTORY BOUNDARIES

Source: (P-8)

Figure 2-19

For example, monitoring sites located near agricultural land, construction sites, or sand and gravel pits have the potential for exceeding 24-hour standards, especially on days with unusually high winds.

For analytical purposes, pollutant sources may be divided into two categories: stationary sources and mobile sources. As shown in Table 2-V, approximately 80 percent of all pollutants in the Reno area in 1973 were due to mobile sources. In this category, the automobile is by far the most important source, being responsible for almost 95 percent of all mobile emissions, while aircraft, diesel-powered trucks, buses, and trains account for only a small portion of the total mobile emissions.

Incineration and open burning acounted for more than 50 percent of all known stationary source emissions in Washoe County (H-11). The lack of heavy industry in Reno serves to keep the amounts of stationary emissions at a minimum. The diatomaceous earth plant, several asphalt and concrete plants, the U. S. Gypsum Plant, sand and gravel plants, the Tracy Power Station, and emissions from unpaved and paved roadways have been identified as significant stationary pollution sources within Washoe County (H-11), although all of these sources may not significantly affect the air quality of the urban area.

Relationship Between Meteorology and Air Quality

Topographic Influences on Wind Speed and Direction - The high peaks of the Sierra Nevada Mountains west of Reno can diminish low-level westerly winds reaching Reno. During the summer, up-slope flows occur during the morning hours on slopes facing eastward as a result of warm air advection caused by the rising sun. During the winter, heat transfer is minimized over snow-covered mountains, thereby reducing up-slope winds (B-2). Since the Truckee River Valley is the basin's only inlet and outlet, calm air is frequently produced, especially during winter nights. Light winds or calm air severely limit the amount of horizontal ventilation in Reno's atmosphere, and extended periods of such conditions can increase the chances of air pollution episodes.

TABLE 2-V

MOBILE AND STATIONARY SOURCES OF
AIR POLLUTANTS - 1973
WASHOE COUNTY

	Tons of Pollutants
Mobile Sources	
Gasoline-Powered Motor Vehicles	154,794
Diesel-Powered Trucks, Buses and Trains	6,242
Aircraft	2,141
Mobile Sources - TOTAL	163,177
Stationary Sources	
Incineration and Open Burning	18,328
Industrial and Commercial Processes	7,421
Combustion of All Fuels to Generate Heat or Power	3,855
Loss of Fuels through Evaporation and Handling	3,758
Stationary Sources - TOTAL	33,362
ALL SOURCES	196,539

Source: (H-11)

A wind rose depicting average frequency of occurrence of winds at Reno from each of the 16 compass directions during each month of the year is presented in Figure 2-20. As shown, stagnant conditions are most likely to occur from September through January, when winds are calm 21 to 32 percent of the time. The TMBAQS showed a definite correlation between calm winds and high carbon monoxide concentrations. The highest carbon monoxide concentrations of the entire study period were observed on January 15, 1975 when wind speeds were lower than 2 mph throughout the Truckee Meadows. On the other hand, highest ozone concentrations occurred on a July day with typical wind speeds which averaged 4 to 8 mph (A-4).

Thermal Inversions - An atmospheric layer in which temperature increases with height is called an inversion. The distance from the earth's surface to the base of an inversion (if one exists) is referred to as the mixing height. A plume of air pollution will generally rise from the earth's surface as long as it is warmer than the surrounding environment. This plume rise will be blocked by an inversion layer, which eliminates vertical mixing and traps pollutants near the earth's surface. The existence of low mixing heights for extended periods of time is an important factor in the development of an air pollution episode.

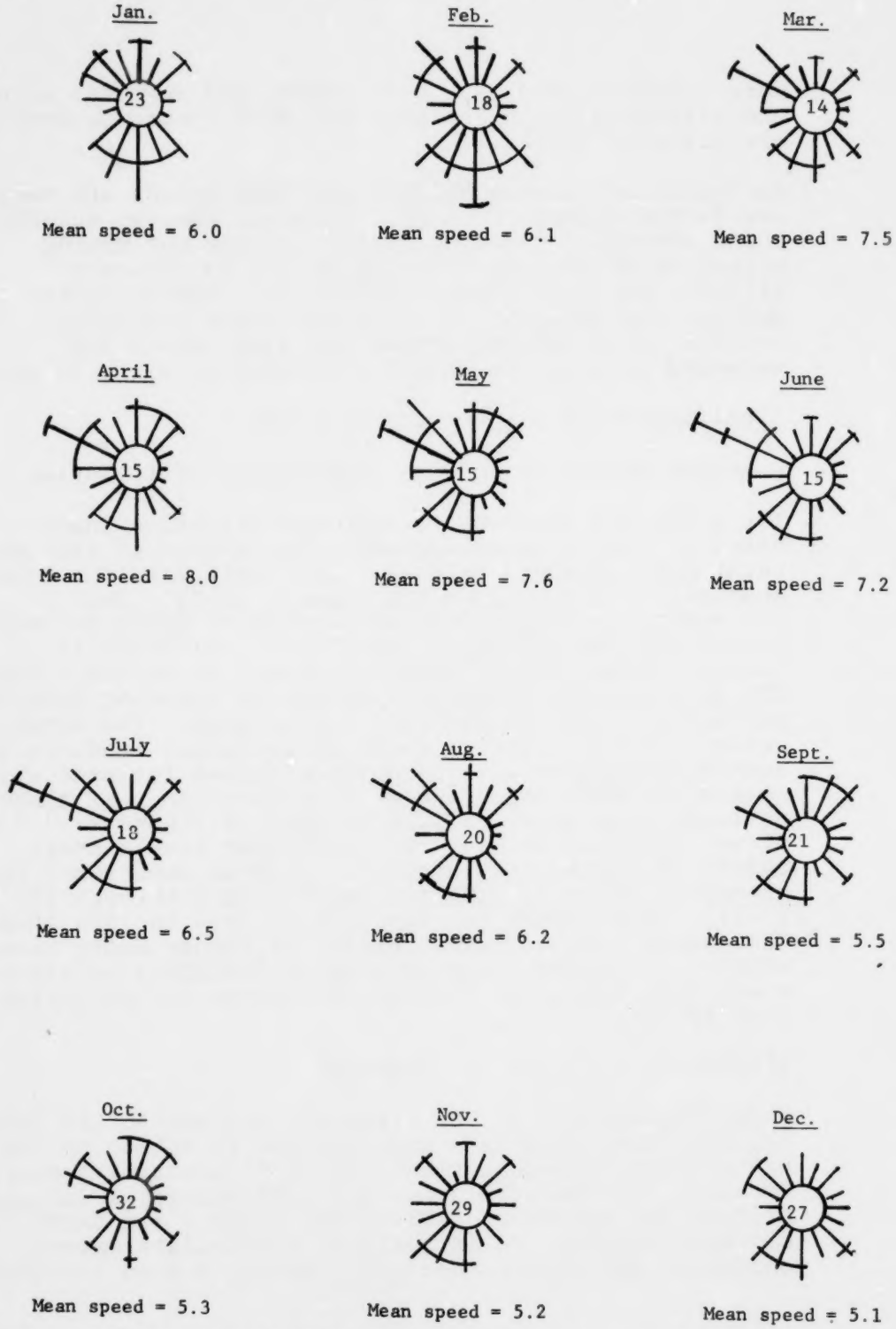
During the TMBAQS, atmospheric soundings showed the existence of a ground-based inversion on 88 percent of the mornings tested. These inversions persisted into the afternoon on less than 2 percent of the days, illustrating the importance of solar surface heating in the break-up of pollutant episode conditions.

Precipitation - Precipitation occurring as rain or snow often reduces concentrations of ambient air pollutants including sulfur oxides, nitrogen oxides and suspended particulates. Reno rarely derives the benefits from such an occurrence, since precipitation in the area is sparse.

Combined Effects and Frequency of Occurrence of Light Winds and Inversions - The Reno area is susceptible to high air pollutant concentrations when there are light winds, low mixing heights and no precipitation for 2 or

FIGURE 2-20

SURFACE WIND ROSES AT
RENO INTERNATIONAL AIRPORT



NOTES: Lengths of lines in wind roses are proportional to the percentage of time wind blew from 16 compass directions. Numeral in center shows percentage of time wind was calm. Period of record 1951-1960.

Source: (C-30)

more consecutive days. Mean annual and seasonal morning and afternoon mixing heights and wind speeds at Reno are given in Table 2-W.

As indicated, mixing heights and wind speeds are very low during summer mornings. However, the sun quickly burns through the mixing layer, raising the mixing height to an average of 2,800 meters and thereby allowing for sufficient ventilation. During winter months, the absence of sufficient solar radiation results in low mixing levels and wind speeds for extended periods, producing a buildup of air pollutants.

- Significance of Air Quality Problems

Combined Pollution Index - Description of Pollution Levels

The WCDHD has developed a Combined Pollution Index (CPI) based on levels of carbon monoxide, oxides of nitrogen, total hydrocarbons, oxidants, and coefficient of haze measured at Evans and Plaza Streets (B-2). The CPI assigns a single numerical value to daily pollution levels and, depending on that level, pollution is labeled clean, light, moderate, heavy or severe. The CPI is primarily a public information service, describing pollution levels in laymen's terminology. The interaction between current levels of pollutant loadings in Reno's atmosphere and the meteorological features which govern the dispersion and/or transformations of these pollutants is graphically displayed in Figure 2-21. As shown, moderate to heavy air pollution levels occur mainly in winter and late fall, with an occurrence frequency of 30 to 37 days per year in 1972 through 1974 (I-1). This number increased to 48 days in 1975 (R-26). The summer months, characterized by almost daily occurrences of shallow inversions which dissipate by afternoon, have almost no moderate to severe air pollution days (H-11).

Efforts to Improve Air Quality

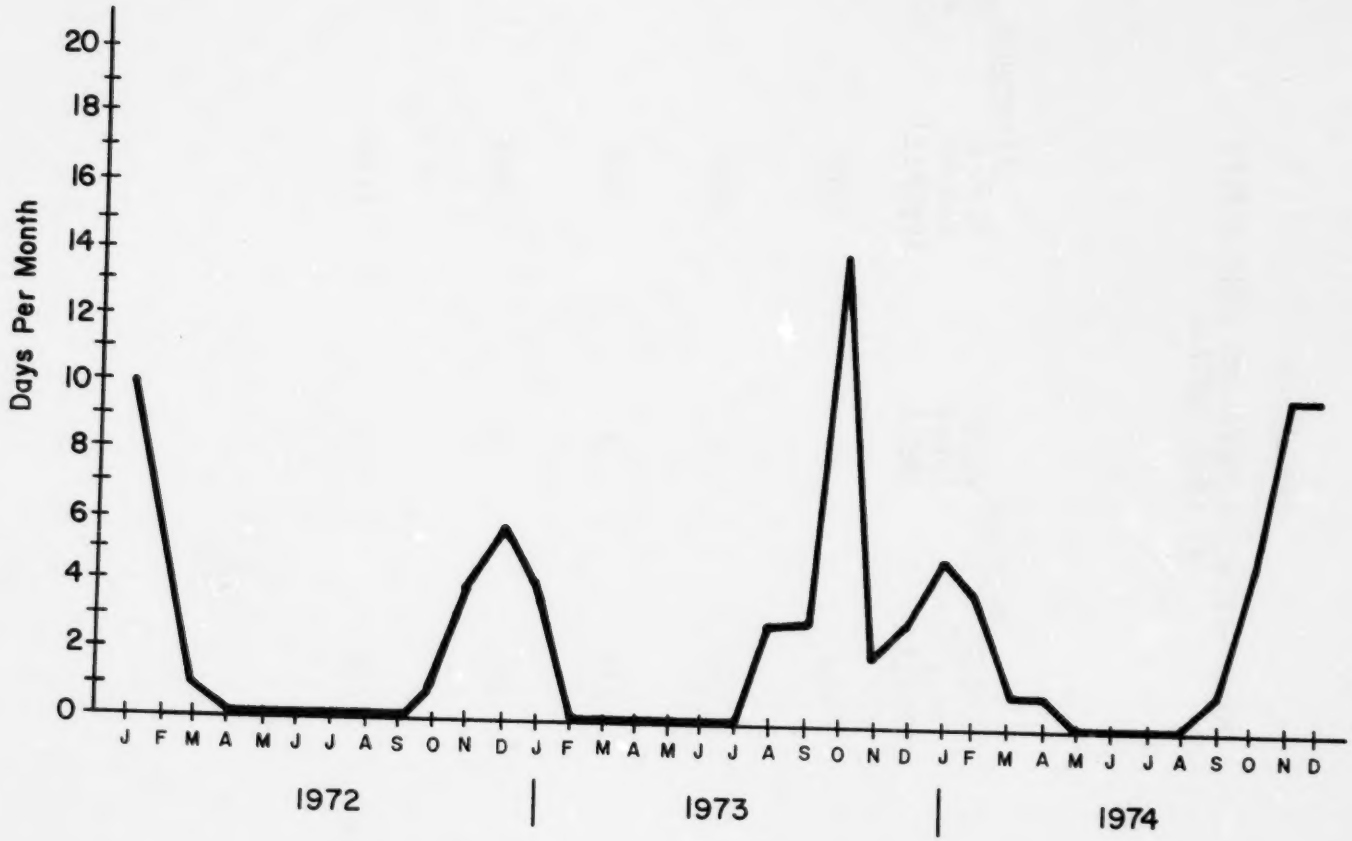
Under Section 110 of the Clean Air Act and 40 CFR Part 51, the State of Nevada was required to submit to the EPA a State Implementation Plan (SIP) containing control strategy for the attainment and maintenance of national primary and secondary ambient air quality standards for nitrogen dioxide, sulfur oxides, particulate matter, oxidants, and carbon monoxide. Nevada's plan for the

TABLE 2-W

MEAN MIXING HEIGHTS AND WIND SPEEDS
AT RENO, NEVADA

Period	Morning Mixing Height (meters)	Morning Wind Speed (mph)	Afternoon Mixing Height (meters)	Afternoon Wind Speed (mph)
Winter	400	6	1100	8
Spring	550	7	2000	12
Summer	275	5	2800	11
Autumn	300	5	1900	9
Annual Average	400	6	2100	10

Source: (H-12)



OCCURRENCES OF "MEDIUM" TO "HEAVY"
AIR POLLUTION LEVELS

Source: (H-11)

Figure 2-21

Nevada Northwest AQCR (Reno) was approved by EPA on May 31, 1972, but disapproved on March 8, 1973 with respect to maintenance of national standards. Nevada had failed to identify the Reno area as an Air Quality Maintenance Area (AQMA) or justify why it should not be designated as an AQMA. Therefore, based on projections that National Ambient Air Quality Standards for particulate matter would be violated during the period 1975 to 1985, the Reno metropolitan area was designated an AQMA by EPA on September 9, 1975 (F-14).

By this designation, EPA is encouraging the State of Nevada and the WCDHD, assisted by an EPA-funded contractor (PEDCo of Cincinnati, Ohio), to analyze the particulate problem in detail (F-14). The study, which is currently in progress and has produced an inventory and projections of particulate emission sources in Reno, is scheduled for completion in October, 1976 and will include an ambient air quality data base and air quality projections (P-8, B-25). If the analysis, formally presented to EPA, confirms that the particulate standards will not be maintained through 1995, EPA will call for development and implementation of an air quality maintenance plan (AQMP) (F-14).

In a letter to the Governor of the State of Nevada dated June 30, 1976, and through formal notice in the July 12, 1976, edition of the Federal Register, the EPA Regional Administrator for Region IX found that Nevada's SIP for the Washoe County portion of the Northwest Nevada AQCR is substantially inadequate for the attainment and maintenance of the primary national ambient air quality standard for carbon monoxide. EPA analysis showed that the national primary 8-hour carbon monoxide standard was exceeded in Reno in 1975, and violations are projected to continue. Under the direction of the Governor of Nevada, the State Environmental Commission must act to revise the SIP to include all achievable emission limitations needed to assure attainment of the national primary standard for carbon monoxide by July 1, 1977. If additional control measures such as land use and transportation plans are needed to attain national primary standards, these must be submitted for inclusion in the SIP by July 1, 1978 (F-14).

Acoustics

Table 2-X lists noise samples taken within the service area. The location of samples is shown on Figures 2-22-A and 2-22-B. Figure 2-23 is taken from the Environmental Protection Agency's Publication 550/9-74-004, and provides graphic examples of recent (1973) outdoor day-night noise levels (L_{dn}) at typical locations throughout the country. With but few exceptions the existing noise levels in the study area are lower than generally found in comparable situations. Only a few miles from the urban centers of Reno and Sparks very low sound levels, such as Samples 4, 10, 11, and 13, can be found which would be off the bottom of the scale shown on Figure 2-23. The noise levels in the downtown areas of the Cross-Town Sewer extension are generally in the mid-to-low noise levels for an urban area. Along the Truckee River an increase in noise level of from 5 to 7 dBA is encountered due to river generated noise.

Areas near Reno International Airport, along the railroad right-of-way and near major traffic arterials experience typical noise levels usually found in the vicinity of these types of sources.

The state has implemented vehicle noise ordinances, and the required federal aviation noise studies and land use compatibility plans have been prepared. Other noise studies and ordinance relations to land use or public health have not been implemented.

URBAN SYSTEMS

Transportation and Circulation

- Existing Roadways and Traffic

  Several major roadway facilities presently serve both local and through traffic in the study area. The Reno-Sparks major roadway network and associated volumes are shown in Figure 2-24. Many of the arterials in this network are four lanes, some with divided roadways and/or left-turn channelization. The majority of the designated collector streets are two lanes.

  Interstate 80 is the major east-west facility traversing the area, essentially providing a major link from the California border near Verdi, through Reno east to Wadsworth and ultimately across northern Nevada to the Utah border.

TABLE 2-X

SERVICE AREA NOISE SAMPLES

Sample Number[a]	L_{dn} Noise Levels (dBA)	Location/Comment
1	47	Plaza Street between Lake Street and Evens Avenue in downtown Reno - surface parking
2	80	Same location as Sample 1 with locomotive passing by sounding whistle, warning devices
3	83	Same location as Sample 1 with two locomotives (one each direction), with warning devices without whistle
4	29	Pyramid Lake occasional car traffic 1/4-mile away
5	61	Sierra Street at Island Avenue
6	62	Island Avenue at Rainbow Street (next to river)
7	55	Same as Sample 6 (across street from river)
8	50	Riverside Drive between Bell Street and First Street without traffic
9	67	Same as Sample 8 with traffic
10	35	Spanish Springs Road at Goldy Way
11	32	Spanish Springs Road at Section 36
12	42	Mayberry Road at Truckee River
13	37	Field east of the Town of Verdi
14	55	Entrance to joint water pollution control plant

NOTES: [a]See 2-22-A and 2-22-B for sampling locations.

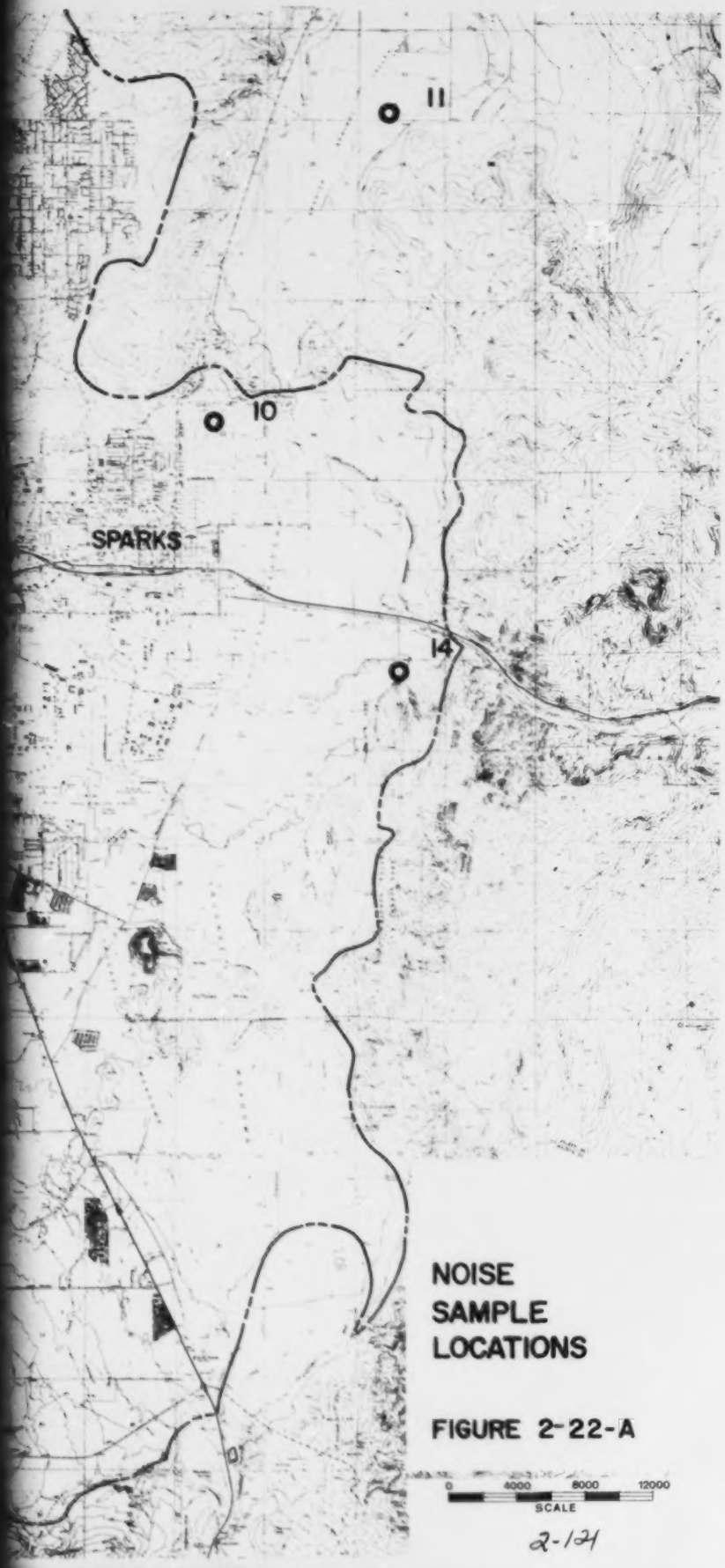
U.S. 395 is a major north-south roadway linking the Canadian border, near Spokane, to Mexico near San Diego. While the southern half of this facility essentially falls slightly within the eastern border of California, it does enter a portion of Nevada while passing to the east of Lake Tahoe. While the Nevada portion of U.S. 395 is relatively short in relation to the total route length, it constitutes a major north-south link in the area by connecting the Stead area north of Reno with Carson City to the south.

Other elements of the major highway network consist of U.S. 40, which generally coincides with I-80 except for the portion through the Reno-Sparks area where it diverges slightly to the south and parallels I-80 as a business route. Two other primary state routes serve the Pyramid Lake area: Route 33 connects Reno to the vicinity of Sutcliff, while Route 32 provides a tie from I-80 at Wadsworth north to Nixon and Empire.

Interstate 80 is constructed to freeway standards. Average daily traffic volumes on this freeway range from approximately 11,000 near the California border to 32,000 at the U.S. 395 interchange. To the east of Reno, volumes gradually decrease to about 4,000 vehicles per day (vpd) east of Wadsworth. The tourist attraction of Reno is exemplified by the fact that 57 to 70 percent of the vehicles on I-80 west of Reno are from out of state while within the central area of Reno only 25 percent are from other states; east of Reno this figure increases to 56 percent at the Wadsworth interchange (E-8).

Traffic on U.S. 395 shows somewhat different characteristics. Since this route links Reno to the State Capitol of Carson City, a much lower percentage of traffic is from other states: 16 to 33 percent between Carson City and Reno. Volumes on U.S. 395 vary from 11,400 vpd at the Carson City limits to 33,000 vpd at Plumb Lane in Reno. From Reno to Stead, volumes are fairly constant at about 12,000 vpd, but decrease to about 4,000 vpd between Stead and the California border (E-8). A portion of U.S. 395 has been relocated and constructed to freeway standards, from Glendale Avenue in the southern part of Truckee Meadows north through Reno to the original alignment at Panther Valley. No volumes are available for this new section.

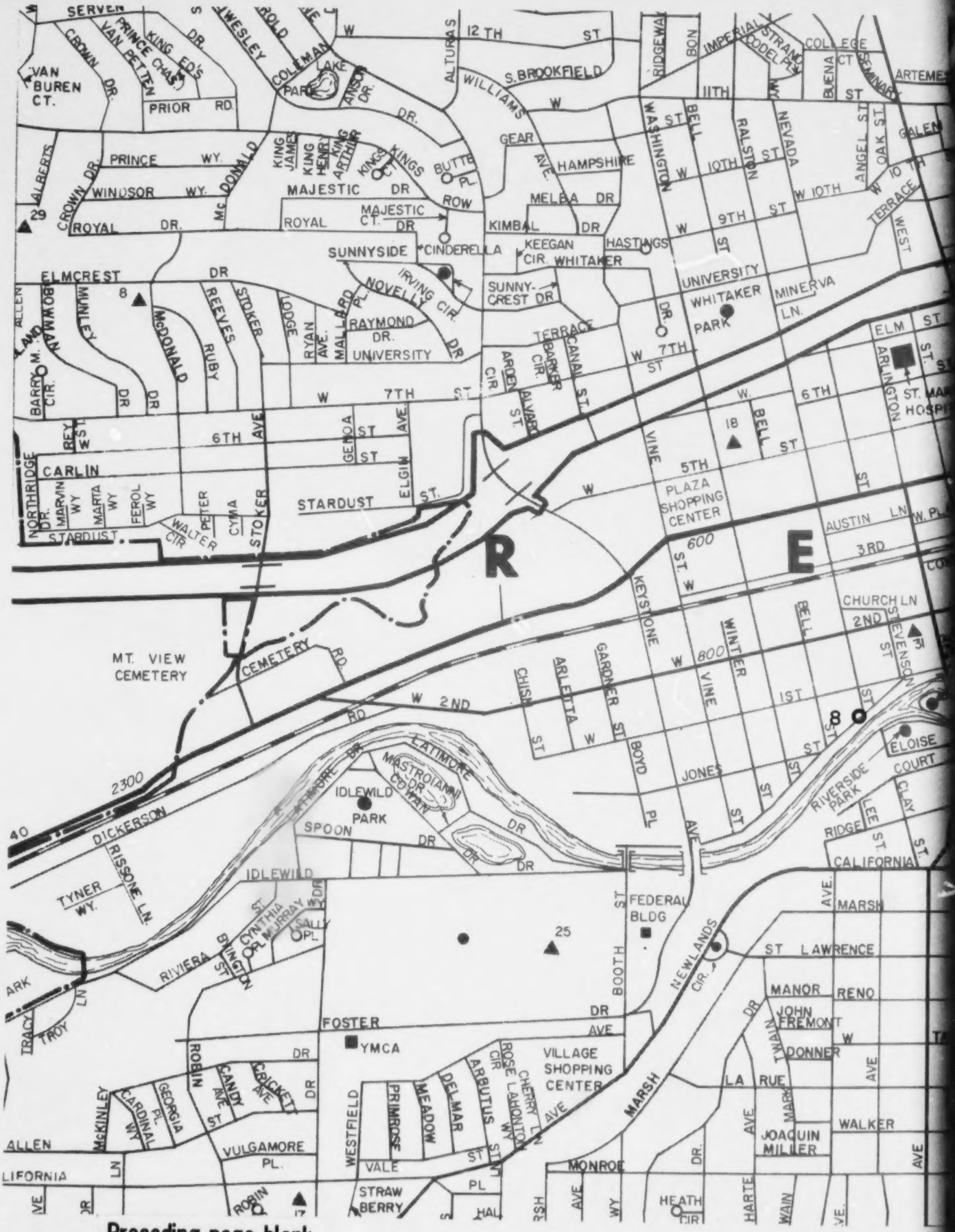
Reproduced from
best available copy.



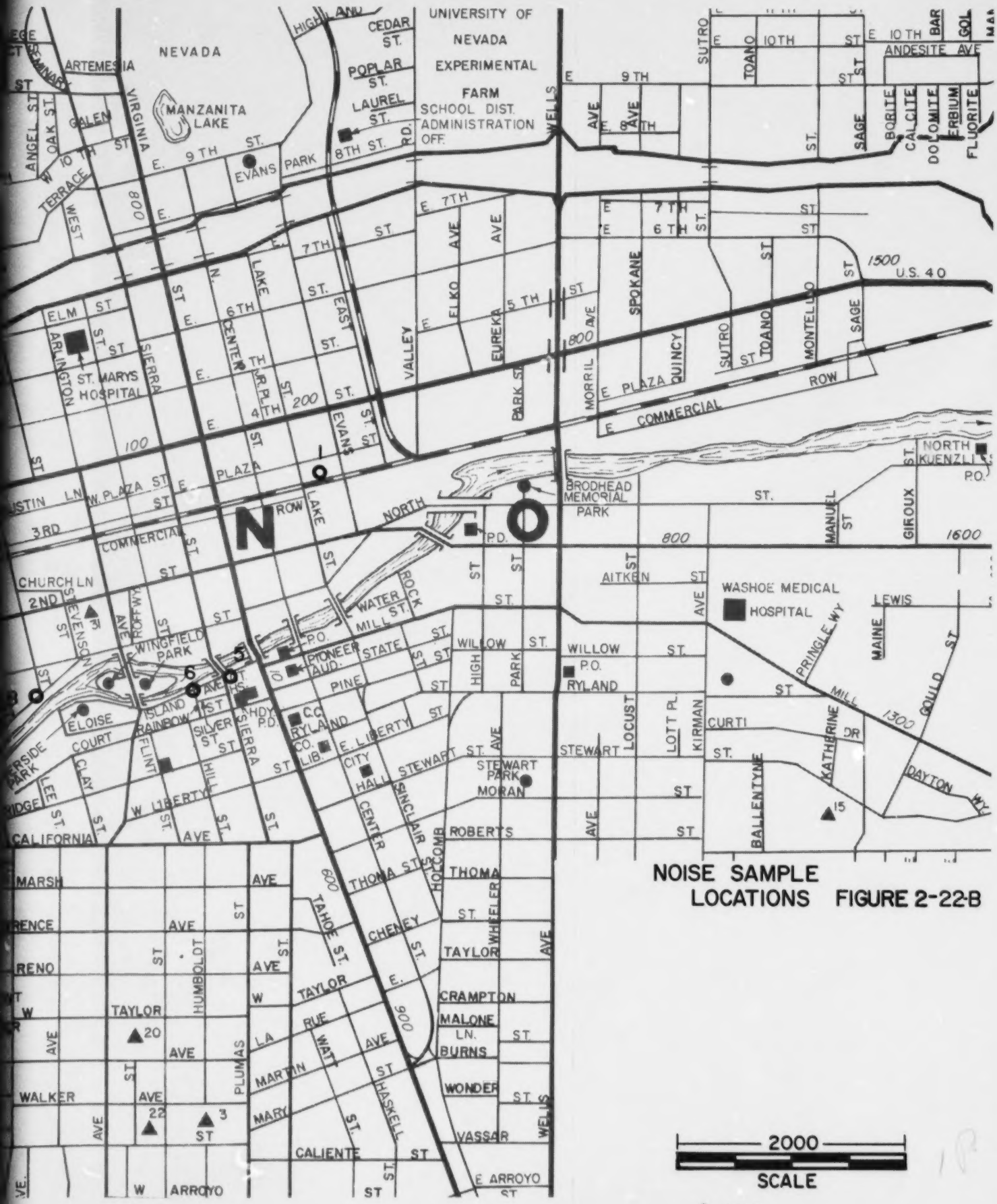
4 (TAKEN AT PYRAMID LAKE)

NOISE SAMPLE LOCATIONS

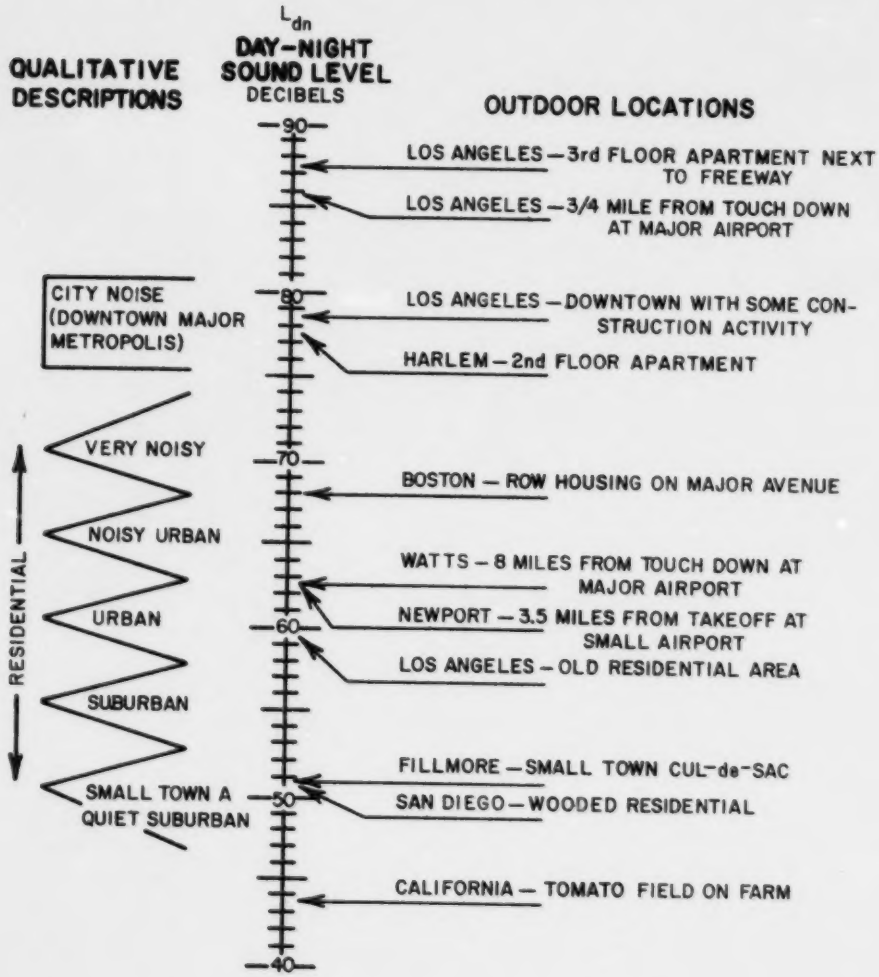
FIGURE 2-22-A



Preceding page blank



NOISE SAMPLE LOCATIONS FIGURE 2-22-B



OUTDOOR DAY-NIGHT SOUND LEVEL IN dB
(re 20 micropascals) AT VARIOUS LOCATIONS

Source:

Figure 2-23

Preceding page blank

Preceding page blank

LEGEND

AVERAGE DAILY TRAFFIC

0-999	———
1,000-4,999	·····
5,000-9,999	– – – –
10,000-19,999	◇ ◇
20,000 & OVER	◆ ····· ◆

ROUTE NO. (32)

FIGURE 2-24

ROAD NETWORK A.D.T.

FIGURE 2-23

0 4,500 9000

Scale

State Route 33 is linked to U.S. 40 in Sparks by Route 32 (Pyramid Way); volumes vary between 3,800 vpd and 12,700 vpd. Volumes on Route 32 peak at 9,600 vpd at Oddie Boulevard but decrease rapidly to the north to 900 vpd near Sutcliffe. Route 34 had a 1974 volume of 625 vpd north of Wadsworth. Major Reno-Sparks roadways and associated volumes are shown in Tables 2-Y and 2-Z.

- Railroads

As pointed out in the historic and archaeologic resources section of this chapter, the Truckee Meadows urban area developed primarily as the result of construction of rail lines. Reno came into being in 1868 when the Central Pacific Railroad, the first transcontinental rail line, was constructed. Sparks was established as a town when the Southern Pacific Railroad moved its division headquarters there from Wadsworth in the early 1900's (E-8).

This mode of transportation continues to serve the area for the movement of both freight and passengers. Average daily freight train operations in Reno include one train in and one out on Western Pacific tracks and 20 to 25 total operations on Southern Pacific lines (E-8).

Amtrack service, provided only on the Southern Pacific route, presently has one passenger train in each direction with daily stops in Reno on the east-west route between Chicago and Oakland. Reno-oriented passenger traffic is relatively light during the weekdays but increases on the weekends, particularly in the winter. The prime amount of this passenger service is between Reno and the San Francisco-Oakland area. Monday through Thursday there are 20 to 30 passengers on both the east and westbound trains. In the winter, a special "Fun Train" is added on the weekends; there are from 40 to 50 passengers on Fridays in each direction, approximately 200 eastbound and 40 to 50 westbound passengers on Saturdays, and the opposite loadings on Sunday to reflect return trips. No special trains are utilized in the summer, but overall traffic increases to about 50 to 60 passengers per day in each direction.

Preceding page blank

TABLE 2-Ya

TRAFFIC VOLUMES OF MAJOR STREETS
IN RENO SERVICE AREA
1974-1975

Location	Number of Lanes	Vehicles Per Day
North-South Streets		
Arlington Avenue - At Plumb Lane	4	9,400
At Court Street	4	21,100
Boynton Lane - South of Mill Street	-	6,600
North of Mill Street	-	12,400
Keystone Avenue - Kings Row to Sunnyside	4	10,400
4th to 5th	4	18,500
Kietzke Lane - SB, South of Peckham	4	6,500
NB, North of Virginia	4	4,800
Plumb to Grove	4	32,600
Lakeside - Hash to Manzanita	2	3,600
Hillcrest to Plumb	2	10,700
Rock Blvd. - Mill to Energy	-	7,000
Terminal Way - At Vassar	4	19,900
Wells Avenue - 6th to 7th	4	19,300
Pueblo to Vesta	4	12,200
Sierra Street - NB, South of 7th	3	8,700
Center Street - SB, South of 7th	2	6,500
Sinclair Street - North of Liberty	2	9,000
Booth Street - At Idlewild	2	4,700
Holcomb Avenue - At Vassar	4	6,600

TABLE 2-Yb

TRAFFIC VOLUMES OF MAJOR STREETS
IN RENO SERVICE AREA
1974-1975
(continued)

Location	Number of Lanes	Vehicles Per Day
East-West Streets		
2nd Street - Sierra to Virginia	4	13,400
4th Street - EB, East of Valley Road	2	7,600
WV, West of Elko Avenue	2	6,500
5th Street - Washington to Ralston	4	7,500
California Avenue - At Mayberry	2	5,000
At Plumas	2	13,900
Commercial Row - At Center	-	4,100
At Court	-	8,100
Mill Street - At Kirman	4	10,100
Center to Lake	2	5,000
Kietzke to Matley	4	14,200
Oddie Blvd. - East of Silverado	4	14,500
Plumb Lane - Hunter Lake to Palisade	4	7,400
Kirman to Yori	4	13,000
Ryland - Wells to Locust	2	7,600

TABLE 2-Z

TRAFFIC VOLUMES OF MAJOR STREETS IN DOWNTOWN RENO
1974-1975

Location	Number of Lanes	Street Width (feet)	Curb Use[a]	Vehicles Per Day[b]
Jones Street - Riverside to Booth	2		Pkg	N/A
Riverside Drive - First to Booth	2	32	No Pkg on S. Side	N/A
First Street - Wingfield Pk. to Riverside	2	40	Pkg	10,000
Mill Street - Kirman to Wells	4	46	Pkg	10,100
Wells to Lake	4	40	Pkg	7,000
Lake to Virginia	2	40	Pkg	5,000
Virginia Street - Mill to Island	4	56	Restricted	18,000
Island Drive - Virginia to Arlington	2		Varies	N/A

NOTES: [a] Pkg = Parking
[b] N/A = Not Available

- Air Transportation

The Reno International Airport has been designated as a port of entry since 1971, thus providing a greater market area for the commercial-tourist oriented trade (E-8). Three major airlines served this facility in 1975 and transported approximately 1,045,000 commerical passengers as well as 9.2 million tons of cargo. In addition, the Reno International Airport accommodated a total of 87,579 transient aircraft (including military), and 41,162 local aircraft operations (E-8).

Additional facilities are available for general aviation through the Reno-Stead Airport. Other landing facilities are located in the vicinity of Pyramid Lake near Nixon and Sutcliffe.

- Public Transit

The Nevada Transit Company, a privately owned operation that has been partially subsidized in the past, serves the Reno-Sparks urban area with seven bus routes (E-8). The majority of these routes operate on broad, circular patterns that are normally considered undesirable in a transit system. However, this method of operation provides a means of obtaining maximum area coverage with a minimum of equipment. Bus headways range from 1/2 hour to hourly service, varying with route, time, and day of operation (E-8). Except for two east-west routes serving downtown Reno and Sparks, service is excluded on Sundays and holidays. The current fare policy is very reasonable and offers special rates for commuters, students and senior citizens. Despite a steady increase in population, however, patronage has not increased proportionately.

Five taxi companies, operating under two ownerships, presently serve the Reno-Sparks metropolitan area. An average of 6,500 total trips are made each day (E-8).

Utilities Other than Wastewater and Water Supply

The Sierra Pacific Power Company provides natural gas, electrical and water service. Bell Telephone of Nevada provides telephone service. Liquified petroleum gas is an important utility for rural residents. There are several distributers of "bottled" gas in the area including CAL Gas Reno Inc., Nevada Propane Company Inc., Petrolane Gas Service, University Chevron Service and Washoe Vangas.

Flood control on the Truckee River is the responsibility of the Army Corps of Engineers. By agreement, the Cities of Reno and Sparks as well as Washoe County provide maintenance service for flood control facilities within their relative jurisdictions.

An example of the flood control activities of the U.S. Corps of Engineers is the program of channel improvements in the Truckee River below Vista which was accomplished in 1959. Alluvial soils in the Truckee River bed had been washed away exposing bedrock outcroppings. These outcroppings were known as the Vista Reefs and obstructed river flows. The Corps project lowered the river bed through the reefs by about 3 feet. This improvement resulted in increased channel capacity and a lowering of the groundwater table in Truckee Meadows, a significant factor in reducing infiltration to existing sewer lines.

Energy Supply/Demand

In general the state of Nevada is currently a net importer of electric energy, and must also import the fuel required for power generated within the state. The situation within the study area is analogous to the rest of the state with respect to energy. The Sierra Pacific Power Company is the principal supplier of energy service in the service area. A composite of the company's output to the power lines for 1974 revealed that the company was dependent on the following sources:

Hydroelectric power generation

Oil fuel electric power generation

Gas fuel electric power generation

Purchases for Pacific Gas and Electric, Southern California Edison, and Utah Power and Light Company

Of the power produced by Sierra Pacific Power Company in 1974, 65 percent was generated locally with imported fuels; 35 percent of the power was purchased from out-of-state power companies. Only 3 percent of the total was hydroelectric generated or independent of fuels. Natural gas supplied to the service area is entirely imported. Energy supplies have been available to meet existing demands. Tables 2-AA, 2-BB, 2-CC and 2-DD indicate the historic consumer costs and total electric and natural gas consumption during the years between 1964 and 1974. Electrical energy costs for residential customers have increased 33 percent in 10 years from 2.49 cents to

TABLE 2-AA

ELECTRIC REVENUE BY CLASSES
SIERRA PACIFIC POWER COMPANY
1964-1974[a]

Year	Residential	Percent of Total	Small Commercial & Industrial	Percent of Total	Large Commercial & Industrial	Percent of Total
1974	$21,768,000	39.1	$22,097,000	39.7	$7,824,000	14.1
1973	$18,180,000	39.6	$18,777,000	40.9	$6,138,000	13.4
1972	$16,037,000	39.6	$16,763,000	41.4	$5,539,000	13.7
1971	$13,439,000	39.4	$14,222,000	41.7	$4,721,000	13.8
1970	$11,788,000	38.3	$12,874,000	41.9	$4,561,000	14.8
1969	$10,657,000	38.8	$11,716,000	42.7	$3,693,000	13.5
1968	$ 9,597,000	38.7	$10,931,000	41.1	$2,962,000	11.9
1967	$ 8,957,000	39.0	$10,190,000	44.4	$2,594,000	11.3
1966	$ 8,573,000	39.9	$ 9,616,000	44.7	$2,055,000	9.6
1965	$ 8,165,000	41.4	$ 8,474,000	43.0	$2,014,000	10.2
1964	$ 7,750,000	42.9	$ 7,569,000	41.9	$1,767,000	9.8

NOTES: (a) Residential increase 1964 to 1974 = 180.9 percent
Small commercial and industrial increase 1964 to 1974 = 191.9 percent
Large commercial and industrial increase 1964 to 1974 = 342.8 percent

Source: (S-4, S-10, S-26)

TABLE 2-BB

ELECTRICAL RESIDENTIAL CUSTOMER DATA
PER AVERAGE CUSTOMER
SIERRA PACIFIC POWER COMPANY
1964-1974[a]

Year	KWH Per Customer	Revenue Per Customer	Cents Per KWH Sold
1974	8,015	$224.47	2.80
1973	8,317	$201.34	2.42
1972	8,222	$194.25	2.36
1971	8,080	$176.60	2.19
1970	7,535	$166.74	2.21
1969	7,359	$162.83	2.21
1968	6,917	$155.90	2.25
1967	6,664	$151.29	2.27
1966	6,432	$147.86	2.30
1965	6,256	$147.77	2.36
1964	6,023	$149.93	2.49

NOTES: [a]1964 to 1974 increase = 33.1 percent

Source: (S-4, S-10, S-26)

TABLE 2-CC

GAS REVENUES BY CLASSES
SIERRA PACIFIC POWER COMPANY
1964-1974[a]

Year	Residential General	Percent of Total	Residential Space Heating	Percent of Total	Commercial General	Percent of Total
1974	$180,000	2.0	$4,517,000	49.1	$1,381,000	15.0
1973	$151,000	2.0	$3,997,000	54.8	$ 596,000	8.2
1972	$114,000	1.8	$3,604,000	56.9	$ 501,000	7.9
1971	$ 99,000	1.7	$3,308,000	58.2	$ 444,000	7.8
1970	$ 80,000	1.7	$2,785,000	58.3	$ 400,000	8.4
1969	$ 72,000	1.7	$2,563,000	58.8	$ 331,000	7.6
1968	$100,000	2.6	$2,306,000	61.1	$ 276,000	7.3
1967	$ 86,000	2.4	$2,214,000	62.6	$ 247,000	7.0
1966	$ 66,000	2.2	$1,986,000	65.0	$ 264,000	8.7
1965	$ 68,000	2.5	$1,816,000	66.8	$ 262,000	9.6
1964	$ 73,000	2.7	$1,822,000	68.7	$ 289,000	10.9

NOTES: (a) Residential general increase 1964 to 1974 = 146.6 percent
Residential space heating increase 1964 to 1974 = 147.9 percent
Commercial general increase 1964 to 1974 - 477.9 percent

Source: (S-4, S-10, S-26)

TABLE 2-DD

GAS RESIDENTIAL AND SPACE HEATING CUSTOMER DATA
PER AVERAGE CUSTOMER
SIERRA PACIFIC POWER COMPANY
1964-1974[a]

Year	Therms Per Customer	Revenue Per Customer	Cents Per Therm Sold
1974	862.1	$156.70	18.2
1973	955,0	$149,23	15.6
1972	975.2	$149.03	15.3
1971	1,005.4	$150.74	15.0
1970	907.8	$139.24	15.3
1969	922.9	$140.76	15.3
1968	882.8	$136.66	15.5
1967	909.1	$138.77	15.3
1966	831.0	$130.00	15.6
1965	825.5	$130.22	15.8
1964	816.0	$149.45	18.3

NOTES: (a) Therms per customer increase 1964 to 1974 = 5.7 percent
Revenue per customer increase 1964 to 1974 = 4.9 percent

Source: (S-4, S-10, S-26)

2.8 cents per kilowatt hour. Consumption has risen from 6,023 to 8,015 kilowatt hours per customer. Between 1964 and 1974, Sierra Pacific Power Company's revenues experienced a slight shift from the residential class and small commercial and industrial class (which were down 3.8 and 2.2 percent, respectively) to large commercial and industrial users (which were up to 4.3 percent) and other classes (which increased 1.7 percent).

Natural gas prices dipped from 18.3 cents per therm in 1964 to a low of 15.0 cents per therm in 1971 and increased again to 18.2 cents per therm in 1974. Residents were consuming 5.7 percent more therms in 1974 than they had in 1964, up from 816.0 therms per customer in 1964 to 862.1 therms in 1974. 1971 was a peak year for residential natural gas use with 1005.4 therms consumed per customer. As a source of revenues for Sierra Pacific Power Company, general residential use in 1974 was down 0.7 percent and residential space heating was down 19.6 percent, while general commercial use was up 4.1 percent, and other sources were up 17.7 percent since 1964.

CHAPTER III

LOWER TRUCKEE RIVER - PYRAMID LAKE BASIN SYSTEM

INTRODUCTION

Within the environmental setting of the Truckee River Basin, as summarized in Chapter 2, the functional characteristics of the river system are of prime significance. These characteristics are both God and man-given in the sense that natural climate, topography and hydrology determines the initial quantity, quality and course of Truckee River water, while man modifies these factors by means of physical works, water use and water law covering the rights of water usage.

The hydrology of the Reno-Sparks Metropolitan Area and the surrounding Truckee River Basin centers on the movement of water into, out of, and within the basin. Examination of this hydrologic cycle reveals the physical processes by which water moves through the environment, beginning with precipitation and ending with evapotranspiration to the atmosphere. Between precipitation and evapotranspiration, water passes through surface water and/or groundwater phases and can remain in one of these phases for a matter of hours or many years before returning to the atmosphere. The hydrologic cycle is important in the Truckee River Basin not only because the basin is land-locked and completely isolated from the sea, but also because water is a key resource within the arid Nevada environment. Important aspects of the Truckee River Basin's hydrologic environment include surface water and groundwater hydrology, water quality, water use and management.

The Truckee River is an interstate stream. It is subject to a complex set of California and Nevada water laws, legal agreements, and federal court actions. Nevada has adopted the Doctrine of Appropriation in its entirety while California recognizes rights related to land ownership such as riparian, littoral, correlative (groundwater), and federally reserved as well as appropriation (A-1).

The Doctrine of Appropriation states that waters of a stream may be appropriated for use for beneficial purposes subject only to the rights of any prior appropriator. A water right is similar to a property right, in that it can be transferred from one piece of land to another and the manner of use can be changed as long as the use continues to be beneficial (K-1).

With the exception of domestic wells that supply less than 1,800 gpd, all waters of the State of Nevada are subject to water right procedures and statutes. The State Engineer is the executive head of the Division of Water Resources and is responsible for the application of complex laws which were enacted during the past century regarding water bodies. All parties that hold water rights must file a proof of appropriation with the State Engineer. Approximately 13,000 parties currently hold water rights within the Truckee River Basin. (A-1).

WATER RIGHTS HISTORY

Statutes relating to water rights were enacted by the Nevada legislature as early as 1866. Early mining booms and irrigation development soon resulted in confusion regarding water rights. Court decisions and additional legislation attempted to correct the situation, but was an expensive and tedious process. In order to expedite water-related matters, the Act of 1903 that established the Office of the State Engineer was passed February 16, 1903. This act, commonly referred to as the Irrigation Act of 1903, declared that all natural water courses, natural lakes, and the waters thereof which were not held in private ownership, belonged to the public and were subject to appropriation for a beneficial use. It also stated that the right to use the water appropriated for irrigation would be appurtenant to the land to be irrigated, and beneficial use would be the basis, the measure and the limit of the right (S-8).

The philosophy of the Act of 1903 was amended, clarified, and further expanded by major legislation in the Acts of 1905, 1907, 1909, 1913, 1939, 1967, 1969, 1971 and 1973 (S-8).

Judicial proceedings on waters of the Truckee River have established policies of water use within the basin. After the completion of the Newlands Project near Fallon in 1915, the United States initiated a condemnation action in Federal District Court against the Truckee River General Electric Company. The resulting decree gave the federal government a perpetual easement to land at the outlet of Lake Tahoe, and the dam at that point, together with storage rights and operating rights to control releases. The decree stated that the power company has a right to an average flow rate of 500 cfs from March through September, and an average of 400 cfs from October through February, as measured at Floriston for the purpose of power generation (known as Floriston Rates) (S-8).

Water shortage problems of the early 1930's led to the Truckee River Agreement of 1935. Parties to the agreement included the Bureau of Reclamation, Truckee-Carson Irrigation District, Washoe County Conservation District, and the Sierra Pacific Power Company. The States of California and Nevada in addition to Lake Tahoe landowners did not participate in the agreement. The agreement modified the Floriston Rates as summarized in Table 3-A. In addition, the agreement stipulated that the level of Lake Tahoe must not exceed 6,229.1 feet mean sea level (msl) or drop below 6,223.0 feet msl. Finally, the agreement called for the construction of Boca Reservoir on the Little Truckee River to supplement Truckee River flows during dry periods. Boca Reservoir was completed in 1939.

The Orr Ditch Decree of 1944 redefined the irrigation rights in the Truckee River Basin, affirmed certain water rights of the Pyramid Lake Paiute Tribe of Indians, and clarified the rights of power plants. The Truckee River Agreement of 1935 was incorporated into the 1944 decree, and reservoir operating procedures were established so that the Floriston rates could be maintained.

In 1955, the legislature established the California-Nevada Interstate Compact Commission for the purpose of distributing the waters of the Truckee, Carson, and Walker Rivers and their tributaries. A compact was prepared after extensive negotiations, and the legislatures of California and Nevada approved the compact in 1971. The compact was sent to Congress for approval in 1971, but no action has been taken to date (S-8).

The Pyramid Lake Paiute Tribe of Indians has a suit pending in the U.S. District Court at Reno. The purpose of the suit is to overturn the Orr Ditch Decree of 1944 thus satisfying the Indians' claim that their water rights predate any water rights established by the Orr Ditch Decree or the Truckee River Agreement. The defendants include more than 13,000 water rights' holders in the Truckee River Basin. If the decision is in the favor of the defendants, the trial over water rights will be blocked, and the existing water rights upheld. If the decision is in the favor of the Pyramid Paiute Tribe of Indians, a second trial will be set to determine which group has the first priority to the waters of the Truckee River (N-5). The outcome of this litigation may not be known for months, and possibly years.

TABLE 3-A

TRUCKEE RIVER MINIMUM FLOW AT
CALIFORNIA-NEVADA STATE LINE
(FLORISTON RATES)

Time of Year	Truckee River Minimum Flow (cfs)
March 1 - September 30	500
October 1 - February 28	400
Exceptions:	
If the level of Lake Tahoe is less than 6,226.0 feet and greater than 6,225.25 feet:	
November 1 - March 31	350
If the level of Lake Tahoe is less than 6,225.25 feet:	
November 1 - March 31	300

Source: (S-8)

WATER USE SUMMARY

Water uses can be classified as either consumptive or non-consumptive. Consumed water is either returned to the atmosphere via evaporation or transpiration or incorporated into products for other uses in or out of the basin. Non-consumptive uses include hydroelectric power generation, recreation, and fish and wildlife conservation.

Water used in the Truckee River Basin is obtained from wells, springs and streams. The Nevada State Engineers Office is responsible for keeping records of water rights and water use. The State Engineer must be notified of all surface water diversions and surface water usage. All groundwater usage must also be registered with the State Engineer, with the exception of wells supplying less than 1,800 gpd for domestic use (S-8). The year 1969 is the most recent year for which comparable and comprehensive data are available for all categories of water use and the figures will be used for this analysis.

Irrigation

In 1975, approximately 38,000 acre-feet of Truckee River water was used for irrigation purposes in the Truckee Meadows area. About 1,000 acre-feet was pumped from wells, and about an equal amount of spring water was used. Consumption occurred mainly through evaporation and transpiration by crops. Most of the water not consumed was returned to the Truckee River, with some water entering the groundwater supply.

Public Supply

Of the 41,000 acre-feet withdrawn for public supplies in 1969, 33,600 acre-feet (82 percent) was obtained from streams; the remainder was obtained from wells. The Sierra Pacific Power Company supplied 38,000 acre-feet to approximately 96,000 people in the Reno-Sparks Metropolitan Area.

Estimated public water supply consumption in the Truckee Basin was 8,800 acre-feet in 1969, with about 8,000 acre-feet being consumed in the Sierra Pacific Power Company service area (S-19). Much of the diverted water which was not consumed was returned to the Truckee River. However, significant losses occurred from yard watering, park irrigation and other uses which lead to evapotranspiration.

Self-Supplied Industry

Mining activities, particularly gravel plants, constitute the primary self-supplied industrial operations in the Truckee River Basin. In 1969, wells supplied about 2,100 acre-feet, streams, 1,500 acre-feet, and springs, 80 acre-feet. Approximately 2,000 acre-feet was consumed (S-19).

Power Generation

Electric power generation includes hydroelectric power and cooling water for steam-generated electric power. In 1969, all water used for electric power generation was obtained from stream flow. Approximately 690,000 acre-feet of water was used for hydroelectric power, all of which was returned to the Truckee River for use downstream. About 54,000 acre-feet was used for cooling purposes at steam-generated electric plants, with only a small portion of this water being lost through evaporation from cooling ponds (S-19).

Rural Uses

In 1969, the rural population of the Truckee River Basin was approximately 11,000. About 2,100 acre-feet of water was used for domestic purposes in the basin, and another 120 acre-feet for livestock watering. Most of this water (80 percent) is withdrawn from wells. Consumption amounted to approximately 1,100 acre-feet (S-19).

Interbasin Transfers

An important aspect of water resource management in the Truckee River Basin is the interbasin transfer of water. In the past, approximately 250,000 acre-feet has been transferred out of the Truckee River Basin each year (A-1). Six current diversions surrounding Lake Tahoe account for about 15,200 acre-feet:

1) About 7,500 acre-feet per year is diverted from the Little Truckee River for irrigation purposes in the Sierra Valley of the Feather River Basin.

2) About 3,250 acre-feet per year of domestic sewage from South Tahoe, California is transported to the Carson River Basin.

3) About 1,700 acre-feet per year is diverted from Echo Lake to the American River for power generation purposes.

4) About 720 acre-feet per year is diverted from Marlette Lake for the Carson City/Virginia City municipal water supply in the Carson River Basin.

5) About 1,344 acre-feet per year is diverted from the Stateline, Roundhill Village area of Douglas County, Nevada to the Carson River Basin.

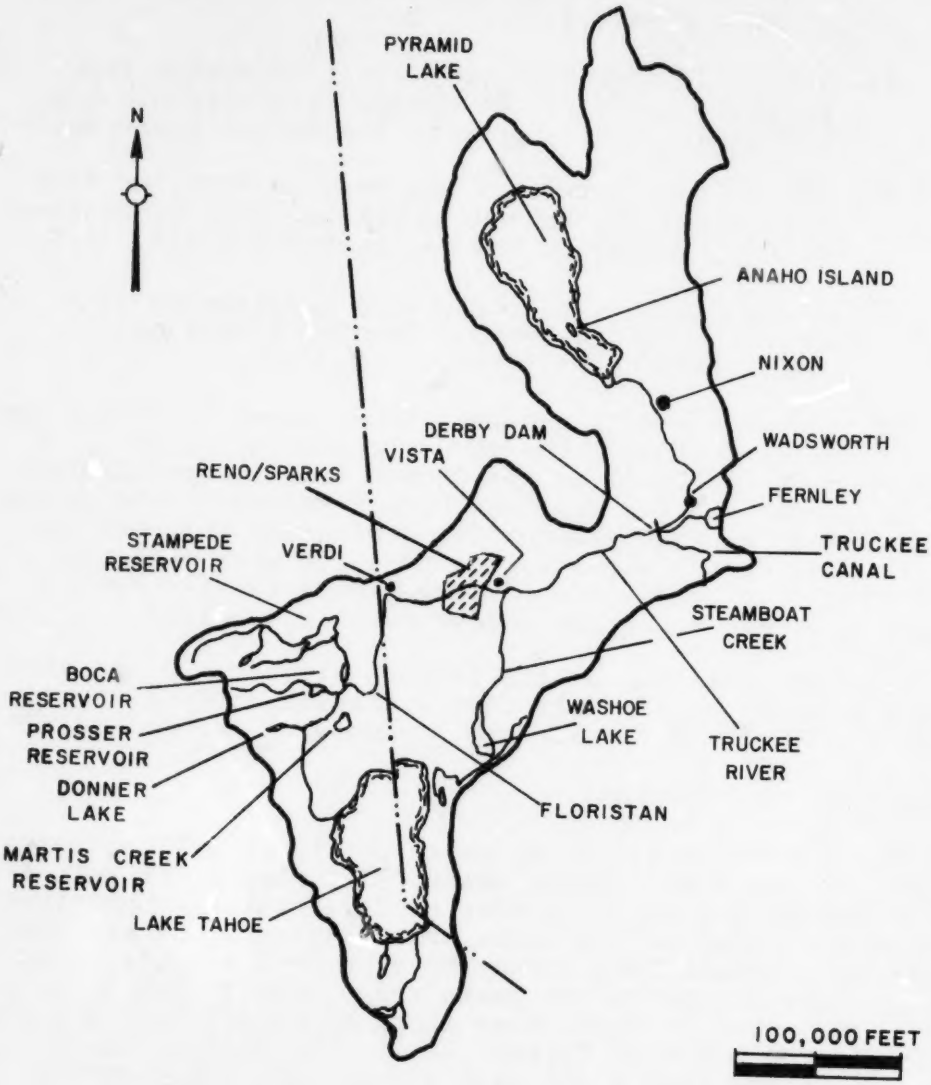
6) About 750 acre-feet per year is diverted from Incline Village, Washoe County, Nevada to the Carson River Basin.

Farther downstream from the Lake Tahoe area, there are two additional diversions. The most significant is at Derby Dam (below Reno) to the Carson Basin; approximately 250,000 acre-feet per year has been diverted to the Newlands Project and the Fernley area for irrigation purposes (K-1). In the Reno-Sparks vicinity, up to 4,700 acre-feet per year (K-1) can be diverted by the Sierra Pacific Power Company to Reno-Stead for domestic water supplies.

Groundwater flows out of the Truckee River Basin are almost negligible due to the fact that mountains forming the watershed divide act as barriers to groundwater movement.

SURFACE WATER HYDROLOGY

The Truckee River Basin, as shown in Figure 3-1, occupies approximately 3,602 square miles; 77.5 percent of this area is in Nevada and the remainder in California. Approximately 398 square miles of the basin are occupied by water; Lake Tahoe and Pyramid Lake occupy 90.9 percent of this total (A-1). Elevations in the basin range from 10,800 feet above sea level at Mount Rose north of Lake Tahoe to 3,460 feet at the bottom of Pyramid Lake. The Truckee River Valley has elevations near 6,300 feet around Lake Tahoe whereas the Truckee Meadows Valley (which surrounds Reno) has elevations as low as 4,400 feet. Near Pyramid Lake, elevations in the Truckee River Valley range in the vicinity of 4,000 feet above sea level. These elevation differences strongly influence rainfall, in that annual precipitation around Lake Tahoe ranges from 20 to 90 inches per year (C-22), while the lower Nevada portions receive from 5 to 10 inches of precipitation per year (R-19).



TRUCKEE RIVER BASIN

Source: (S-19)

Figure 3-1

The Truckee River Basin has two unusual hydrologic characteristics: 1) precipitation occurs in significant amounts only in the far western portions of the basin; and 2) the basin has no outlet to the sea with the Truckee River originating at Lake Tahoe and flowing to Pyramid Lake, approximately 60 airline miles from its source, as the major riverine feature.

Since the basin is located on the eastern slopes of the Sierra Nevada mountain range, the highest elevations in the basin are the mountains to the west and south of Lake Tahoe.

The Truckee River Basin is completely surrounded by mountains and elevated plateaus. In the Sierra mountains, the river receives additional flow from several streams and creeks, but once the river reaches Nevada, little additional water is acquired (V-1). A large number of man-made canals, mostly in Nevada, divert water for irrigation and domestic water supplies. Some water is also lost to groundwater storage, primarily in the Truckee Meadows area.

The Truckee River meanders over 119 miles between Lake Tahoe and Pyramid Lake. There are no water outlets from Pyramid Lake at its present water level, and the hot, arid summers cause significant water losses through evaporation. Some of the water diverted for consumptive uses is returned to the Truckee River; however, since 1905, most water taken from the basin via the Truckee Canal has not been returned to the basin. This has created a net imbalance between inflows and outflows, resulting in an 80 foot drop in the water level of Pyramid Lake (R-19). However, in more recent years, the level has begun to rise with a recovery of approximately 10 feet.

Lake Tahoe, Pyramid Lake and the Truckee River are the primary components of the surface water system within the Truckee River Basin. Smaller lakes in the Sierras include Boca, Stampede and Martis Creek and Prosser Creek Reservoirs and Donner, and Independence Lakes. One of the key tributaries to the Truckee River in the Sierras is the Little Truckee River which flows through Stampede and Boca Reservoirs. All of these smaller lakes are located in California. The environment in Nevada is more arid than that of California. The most significant tributary to the Truckee River in Nevada is Steamboat Creek whose headwaters are at Washoe Lake south of Reno. All streams and creeks in the Nevada portions

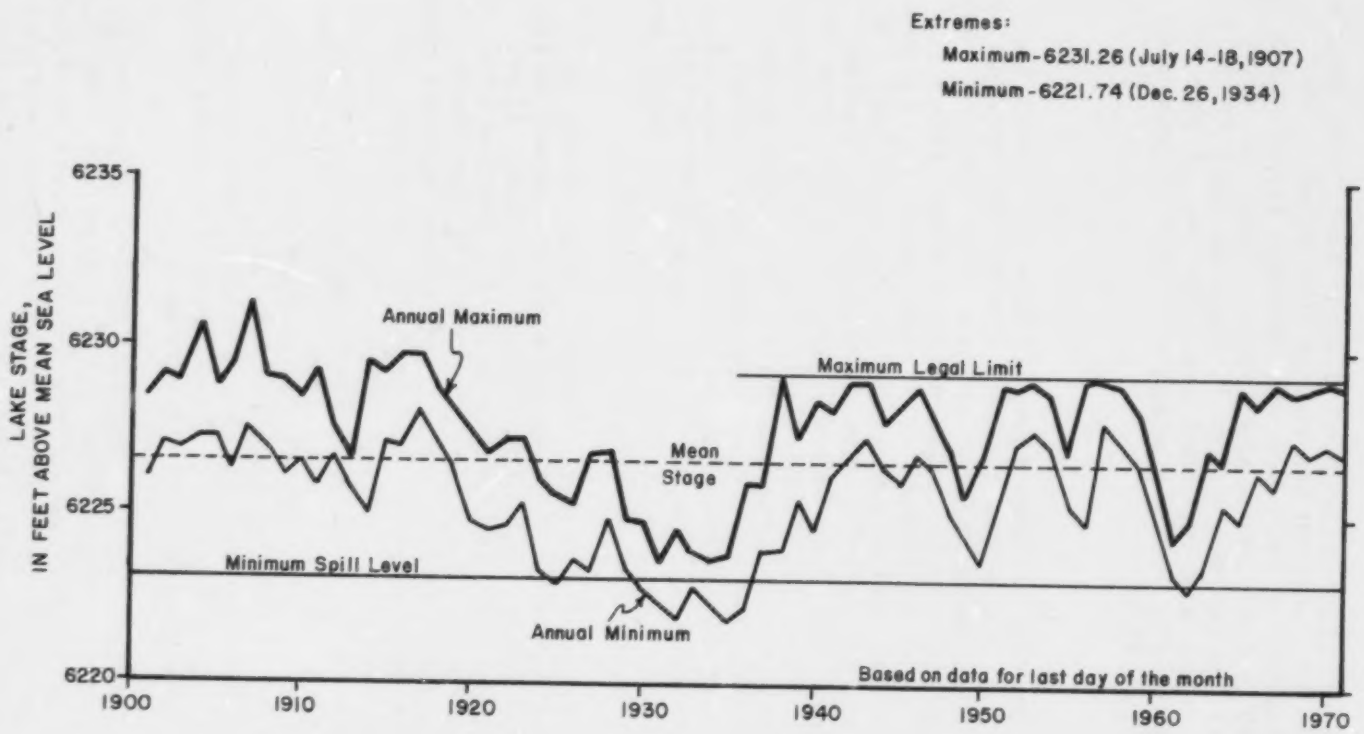
of the Truckee River Basin are of an ephemeral nature, and contribute minor flows to the Truckee River. Surface water components are shown in Figure 3-1.

Lake Tahoe

Lake Tahoe is at the headwaters of the Truckee River, with a natural outlet elevation of 6,223 feet above mean sea level (msl). The lake has a water surface area of 192 square miles and a maximum depth of 1,646 feet (making it the tenth deepest lake in the world). Its volume is approximately 125 million acre-feet (R-19). Lake Tahoe is surrounded by mountains, with the Sierra Nevada range to the south and west and the Carson range to the east. Precipitation in these mountain ranges averages 40 inches annually (R-19), and much falls as snow during the winter and spring. Inflows to Lake Tahoe are highest between April and July, when melting reduces the water in storage in the snow pack on the mountain slopes. Average annual run-off to Lake Tahoe is estimated to be 312,000 acre-feet. An additional 212,000 acre-feet reaches the lake as direct precipitation on its surface (C-23).

Since the 1870's, outflow from Lake Tahoe into the Truckee River has been controlled by a dam at the lake outlet. This dam can regulate outflows and store water in the lake between elevations of 6,223.0 and 6,229.1 feet. Due to Lake Tahoe's large area, this 6.1 foot range amounts to a huge storage volume of 744,600 acre-feet. The dam is operated by the Truckee-Carson Irrigation District for the U.S. Bureau of Reclamation in conjunction with the Newlands Project in the Carson River Basin east of Reno. The District diverts Truckee River water via the Derby Dam and Truckee Canal (Lahontan Diversion) downstream from Reno to irrigate lands near Fallon, Nevada. The dam at the Lake Tahoe outlet is used, in conjunction with the other lakes in the Sierras, to maintain the "Floriston Rates" established in 1908 and modified in 1935 as reported in the previous Water Rights History section of this chapter. These rates stipulate the maintenance of 500 cubic feet per second (cfs) on the Truckee River at Floriston, California, between March and September each year, and from 300 to 400 cfs, depending upon the level of Lake Tahoe, between November and March (C-23).

The annual variations in the stage of Lake Tahoe are shown in Figure 3-2. Within any given year, the lake stage varies from 1 to 2 feet from the annual maximum to the annual



ANNUAL VARIATION IN STAGE OF LAKE TAHOE

Source: (C-23)

Figure 3-2

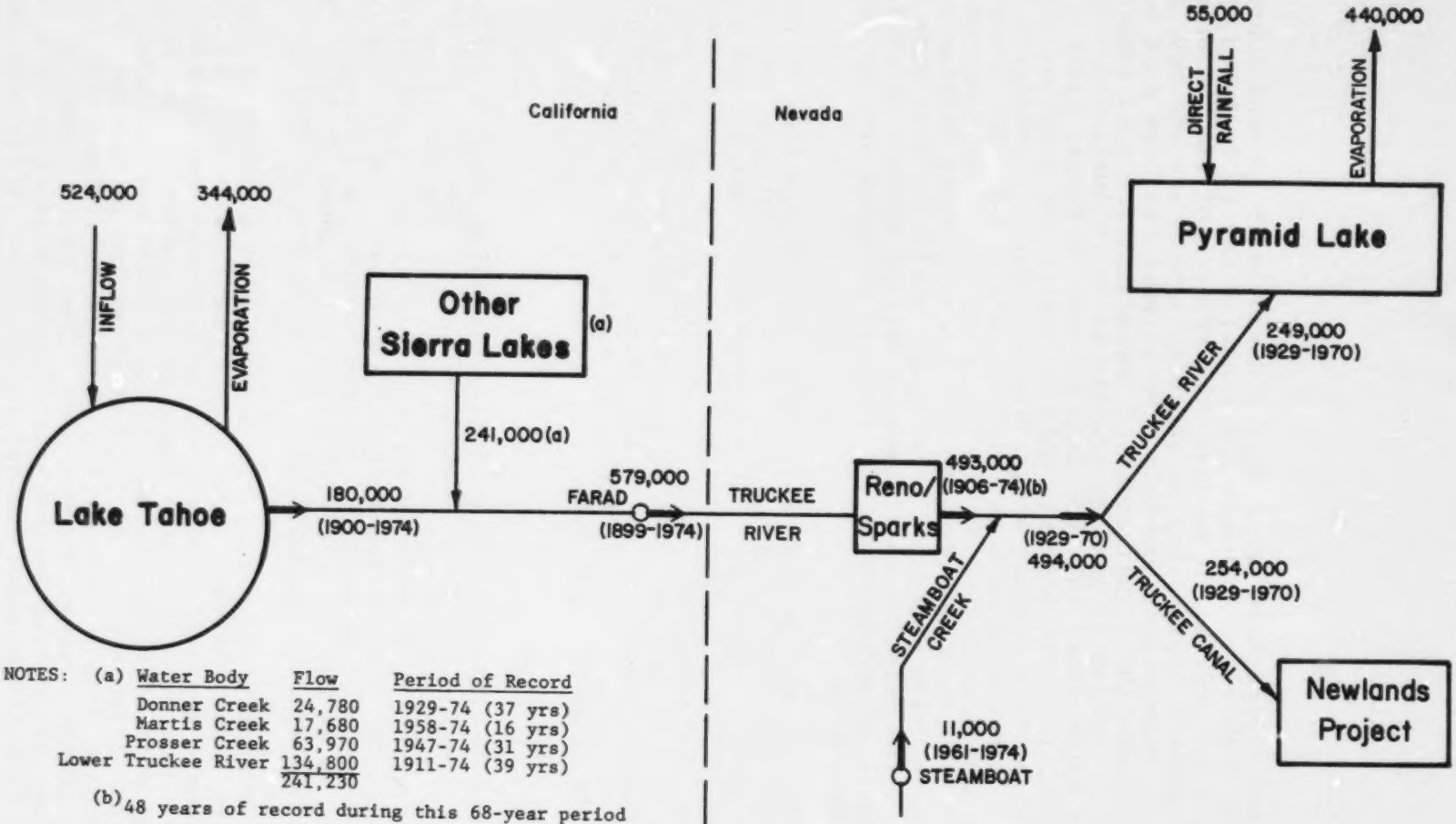
minimum. Significant fluctuations of 5 or 6 feet have resulted from the occurrence of consecutive wet or dry years. The Truckee River Agreement of 1935 set the maximum legal stage for Lake Tahoe at 6,229.1 feet above sea level. Prior to this, the recorded maximum elevation was 6,231.26 feet on July 14 to 18, 1907. The lowest stage was recorded near the end of the dry years of the early 1930's, when a stage of 6,221.74 was measured on December 26, 1934.

Truckee River

The configuration of the Truckee River within the basin is shown in Figure 3-1. Since about 1900, streamflow records on the Truckee River have been kept at several stations for varying periods. A summary of the major surface water flows is presented schematically in Figure 3-3. The total runoff and direct rainfall to Lake Tahoe averages 524,000 acre-feet per year (C-23). From 1900 to 1974, the flow into the Truckee River from Lake Tahoe has been 180,000 acre-feet per year (G-4). Net evaporation is about 344,000 acre-feet per year. Other lakes and tributaries in the Sierras which have been gauged contribute another 241,000 acre-feet per year (G-4) below Lake Tahoe. At Farad, near the Nevada-California state line, the flows have averaged 579,000 acre-feet from 1899 to 1974 (G-4) indicating that ungauged streams between Lake Tahoe and Farad contribute another 158,000 acre-feet annually.

After the Truckee River flows into Nevada, it receives no appreciable new inflows and is diverted into Steamboat Ditch, Orr Ditch, Highland Ditch, and other uses. At Reno, flows averaged 488,000 acre-feet per year during the period 1900 to 1974 (G-4). Below Reno, irrigation returns via the North Truckee Drain, Steamboat Creek system, and other sources make small contributions to the river. A gauge at Steamboat on Steamboat Creek recorded an average annual flow of 11,000 acre-feet from 1961 to 1974 (G-4). Above Derby Dam, flows averaged 474,000 acre-feet annually from 1929 to 1970 (P-2). Diversions by Derby Dam into the Newlands Project averaged 254,000 acre-feet (P-2) during this period, and about 244,000 acre-feet annually has reached Pyramid Lake during this time. Annual flows of the Truckee River for water years 1900 through 1969 are presented in Appendix 6.

Flow records for stations on the Truckee River are generally for different periods and therefore are not directly comparable. Yearly variations in streamflow of the Truckee River at Farad, California are shown in Figure 3-4. In this figure, effects of varying climatological conditions upon the river (in that



NOTES: (a)

Water Body	Flow	Period of Record
Donner Creek	24,780	1929-74 (37 yrs)
Martis Creek	17,680	1958-74 (16 yrs)
Prosser Creek	63,970	1947-74 (31 yrs)
Lower Truckee River	134,800	1911-74 (39 yrs)
	241,230	

(b) 48 years of record during this 68-year period

Source: (C-23, G-4, P-2)

HISTORICAL FLOW AVERAGES IN TRUCKEE RIVER BASIN
(Flows in Acre-Feet per year)

Figure 3-3

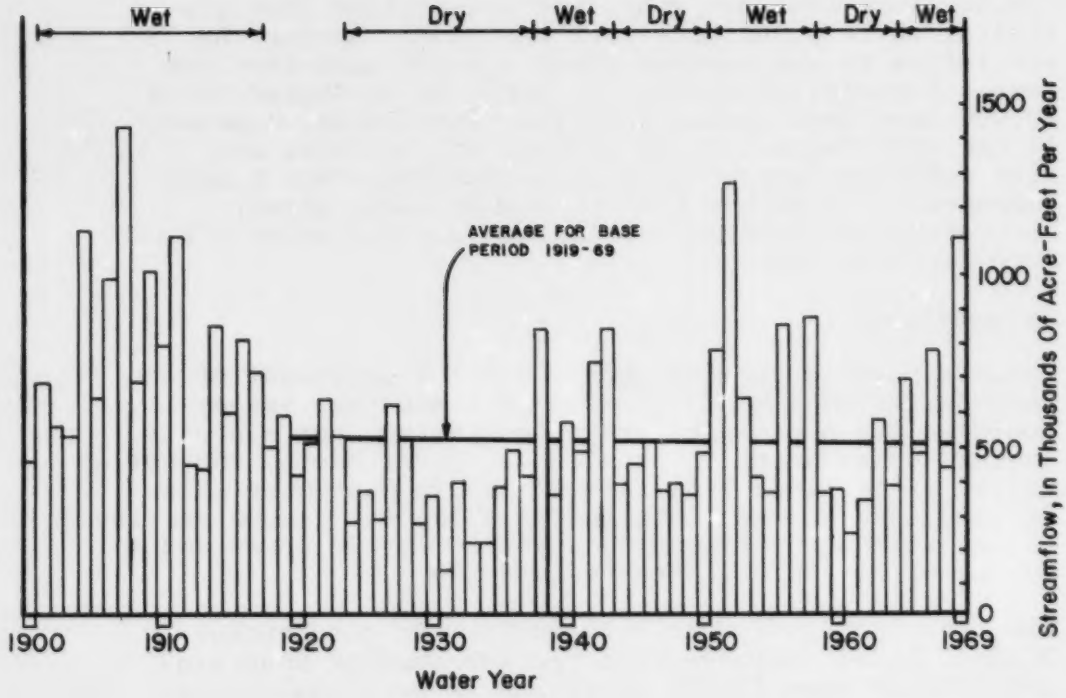
wet and dry periods occur with a duration of several years) can be inferred. Although a wet period may be included in one record but omitted in another, the effects of such omissions over periods approaching 50 years in length are reduced, making general comparisons possible. No attempt has been made herein to evaluate the significance of comparable years of record from gauging station to gauging station or to evaluate which series of years might yield the best data to predict future flows. This document presents historic data to depict the existing environmental setting against which future changes, accomodated by the array of proposed actions, will be contrasted. No attempt has been made herein to evaluate the significance of comparable years of record from gauging station to gauging station or to evaluate which series of years might yield the best data to depict the existing environmental setting against which future changes, accommodated by the array of proposed actions, will be contrasted.

For the 51 year period, 1919-1969, the average flow of the Truckee River at Farad has been about 509,000 acre-feet per year (W-1). The 50 percent probable flow, that is the flow which will be exceeded during half the years and not reached during the remaining years, is 452,000 acre-feet per year for this 51 year period. The 80 percent probable flow, which will be exceeded 80 out of every 100 years is about 352,000 acre-feet per year. The 20 percent probable flow at Farad is 643,000 acre-feet per year.

Truckee Meadows

Truckee Meadows is a broad valley extending along a north-south axis between the Carson Mountain Range to the west and the Virginia Mountain Range to the east. The Truckee River traverses Truckee Meadows in an east-west direction and passes through the Reno-Sparks Metropolitan Area. The Truckee River dominates the hydrology of Truckee Meadows, and accounts for about 75 percent of water entering the meadows (S-19). This area encompasses approximately 203 square miles (S-19).

The Truckee River enters the meadows from a canyon in the vicinity of Verdi, Nevada, about 7 miles west of Reno. The river follows a meandering course eastward across the meadows, and leaves the area through a steep-walled canyon in the Virginia Range east of Vista, Nevada, about 6 miles east of Reno. The largest tributary to the Truckee River in the meadows area is Steamboat Creek, which drains Pleasant Valley and the southern part of the Truckee Meadows area. The northern part of the meadows is drained by the North Truckee Drain flowing southward from the Spanish Springs Valley. Sun Valley also drains into the meadows north of Reno, but contributes an insignificant flow to the river.



ANNUAL STREAMFLOW AT GAUGING STATION
ON TRUCKEE RIVER AT FARAD, CA

Source: (V-1)

Figure 3-4

The water budget for the Truckee Meadows area is shown in Figure 3-5. Inflows to the meadows originate from the Spanish Springs Valley, Sun Valley, Pleasant Valley, and the Truckee Canyon Segment (Truckee River inflows). Natural outflows pass to the Tracy Segment of the Truckee River below Vista while diversions account for outflows to Spanish Springs Valley and Lemmon Valley.

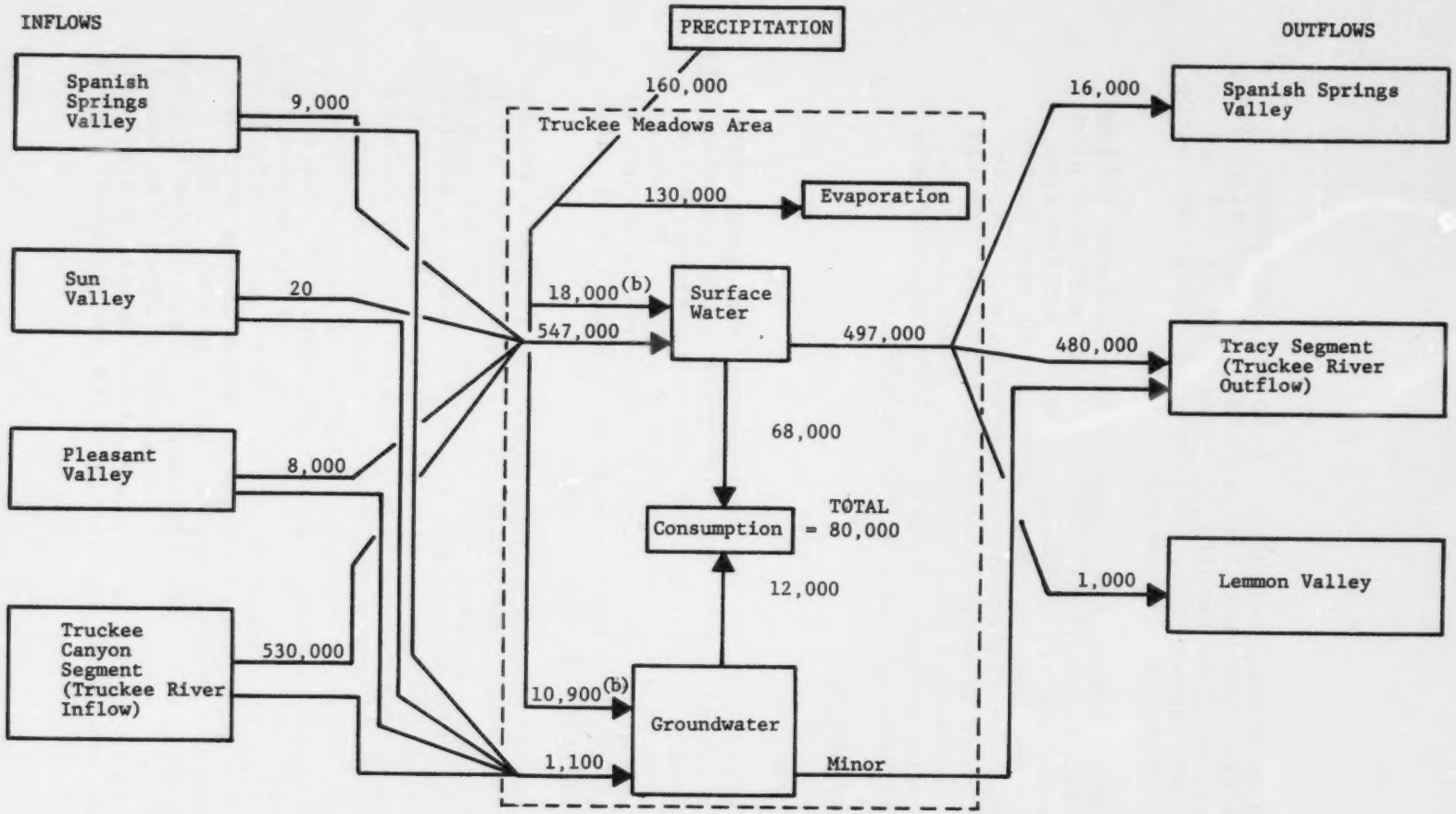
Within Truckee Meadows, inflows are apportioned between surface water (550,000 acre-feet per year), groundwater (28,000 acre-feet per year) and evaporation from precipitation (130,000 acre-feet per year), making the net inflow to the meadows about 578,000 acre-feet per year. Consumption within the basin is estimated to be 80,000 acre-feet annually (V-1). This value, however, is the difference between inflows and outflows and also reflects inaccuracies in estimating other budget components. Outflows from the basin occur almost entirely as surface water, and account for about 497,000 acre-feet per year.

Pyramid Lake

Pyramid Lake is located about 25 miles northeast of the Reno-Sparks Metropolitan Area. Pyramid Lake Valley would be dry because of its arid climate, but since it is the lowest point in the Truckee River Basin, the valley collects the flows from the river. In September 1974, Pyramid Lake had an elevation of 3,796 feet above sea level (G-4), with a corresponding area of 110,000 acres and a volume of 21,280,000 acre-feet (H-8).

The principal inflow to Pyramid Lake is the Truckee River. Local drainage from the surrounding mountains contributes very little water and as previously noted, the lake's only outflow is via evaporation. The lake level fluctuates yearly according to inflows and outflows. Occasional measurements prior to 1900 recorded the lake level in the vicinity of 3,870 feet above mean sea level. At these elevations, the lake had an area of about 140,000 acres and a volume of 31 million acre-feet (H-8).

Assuming that meteorological conditions today are similar to conditions prior to 1900, gross evaporation at Pyramid Lake was about 4 feet per year (V-1). Today, direct rainfall into Pyramid Lake averages about 55,000 acre-feet per year, equivalent to 0.5 feet per year, and net evaporation is



NOTES: (a) All flows in acre-feet per year.
(b) Adjusted to achieve balance within system.

WATER BUDGET FOR TRUCKEE MEADOWS

Source: (S-19)

Figure 3-5

about 440,000 acre-feet per year. Evaporation losses equating to 4 feet per year less rainfall in equivalent feet across the lake surface results in a net loss of 3.5 feet per year. Water surface fluctuations of Pyramid Lake since 1867 are illustrated in Figure 3-6.

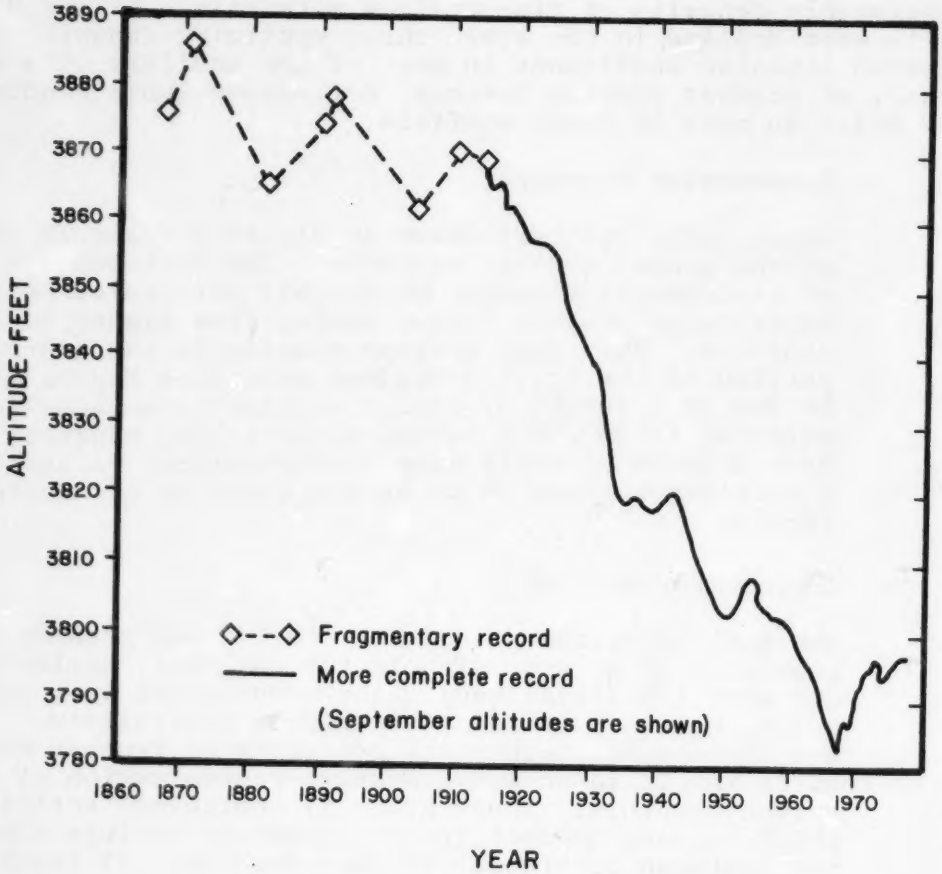
The current water budget for Pyramid Lake includes inflows from the Truckee River of 249,000 acre-feet per year plus annual precipitation of 55,000 acre-feet. Outflow from evaporation is 440,000 acre-feet over the 50 year period (1919 to 1969); the difference of approximately 136,000 acre-feet per year between inflows and outflows accounts for the drop in Pyramid Lake's volume. Since the first diversions to the Newlands Project in 1905, Pyramid Lake has lost 30 percent of its pre-1900 volume.

GROUNDWATER HYDROLOGY

Truckee Meadows

The consolidated rocks in the Reno-Sparks area generally contain very little water. Most of these rocks are classified as igneous, metamorphosed igneous and sedimentary, which contain very few primary interconnected voids. The only significant amount of water found in these rocks occurs in fracture zones in the Kate Peak, Alta, Hartford Hill, and Lousetown Formations (C-24).

The unconsolidated deposits that partially fill the Truckee Meadows Valley contain almost all of the groundwater available in the basin. Thompson and Sandburg (T-12) calculated the maximum depth of the valley fill to be about 2,800 feet. Cohen and Loeltz (C-24) estimate the valley fill to be 4,000 feet. Although groundwater occurs in all types of unconsolidated deposits throughout the area, only certain deposits readily yield water to wells. The major aquifer is apparently a relatively continuous, surface (or near-surface), coarse-grained fluvial deposit, that covers most of the western and southern portion of Truckee Meadows. Cohen and Loeltz (C-24) refer to that portion of the deposit found in the northern portion of Truckee Meadows as the "upper gravel". The alluvial fan deposits along the western flank of the Virginia Range also locally yield small to moderate amounts of water to wells. The rest of the unconsolidated deposits are highly heterogeneous, and water-producing units are generally quite discontinuous (C-29).



WATER SURFACE FLUCTUATIONS OF PYRAMID LAKE

Source: (E-2)

Figure 3-6

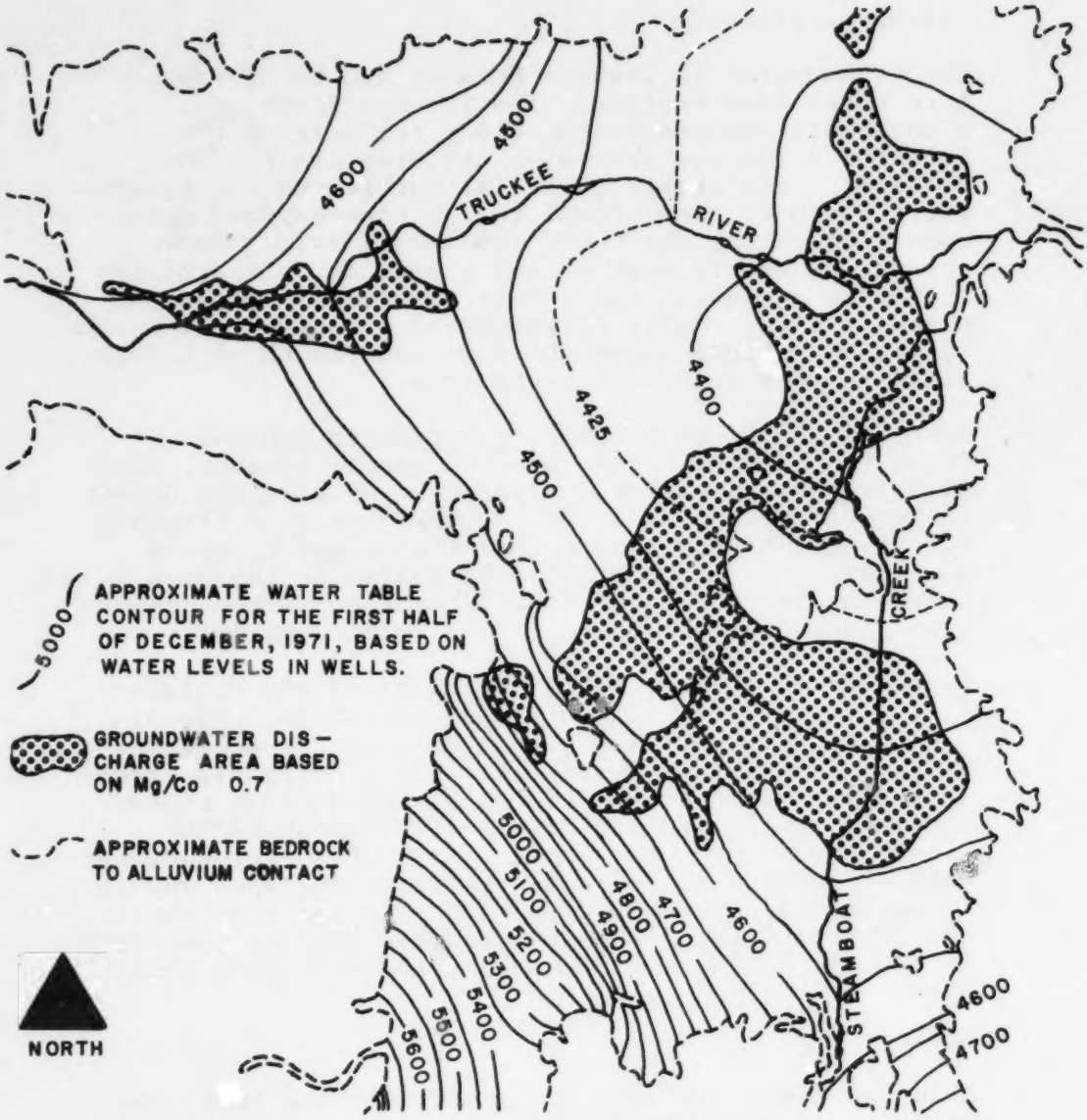
Except for the surficial fluviatile deposits, the rest of the unconsolidated aquifers are generally confined by relatively impermeable deposits of fine-grained materials. Before deep wells were drilled in the area, these confining deposits created artesian conditions in most of the aquifers. As a result of present pumping demands, over-drawn table conditions now exist in many of these aquifers.

- Groundwater Movement

  Water table contours shown in Figure 3-7 are indicative of the ground surface contours. The horizontal component of groundwater movement is roughly perpendicular to the water table contour lines, moving from higher to lower contours. The close contour spacing in the southwest portion of the Truckee Meadows area (see Figure 3-7) may be due to a series of faults within the unconsolidated material (C-29). The actual water table, however, may have a somewhat stair-step configuration, rather than a continuous steep slope as suggested by the contours (C-29).

- Groundwater Quality

  The quality of the groundwater in Truckee Meadows is generally good, and suitable for domestic, agricultural, and most industrial uses. The groundwater in certain areas, however, is naturally highly mineralized. There are three major mechanisms occurring in Truckee Meadows which result in an above average concentration of dissolved minerals. These are: 1) geothermal activity, which is most notable in the Steamboat Springs area in the southern portion of Truckee Meadows; 2) leaching of hydrothermally altered bedrock in the Carson Range to the southwest of Reno, and the area immediately to the northwest of the Reno Fairgrounds; and 3) the concentration of dissolved minerals due to locally high evapotranspiration rates in areas which have a high water table, such as the area north of the Truckee River just west of where the river leaves Truckee Meadows. These areas, and the types of mineralization occurring are easily recognized in Figure 3-8. No explanation has been suggested for the relatively highly mineralized water in the alluvial deposits along the western edge of the Virginia Range, or the area immediately south of the Huffaker Hills (see Figure 3-8).



APPROXIMATE WATER TABLE AND
LOCATIONS OF GROUNDWATER DISCHARGE AREAS
TRUCKEE MEADOWS AREA

Source: (C-29)

Figure 3-7

- Discharge Areas

The groundwater in Truckee Meadows can be divided into three flow regimes. The Truckee River and a northeast-southwest line along the axis of the Huffaker Hills are the major dividing lines. The Huffaker Hills create a partial barrier to the groundwater south of them, resulting in near-surface water conditions along the hills' southern flanks; these conditions enable most of the plants in this area to transpire at nearly their full potential. Steamboat Creek is also a major recipient of groundwater. Studies (C-29, S-24) have shown the low-lands south of Huffaker Hills to be a major discharge area.

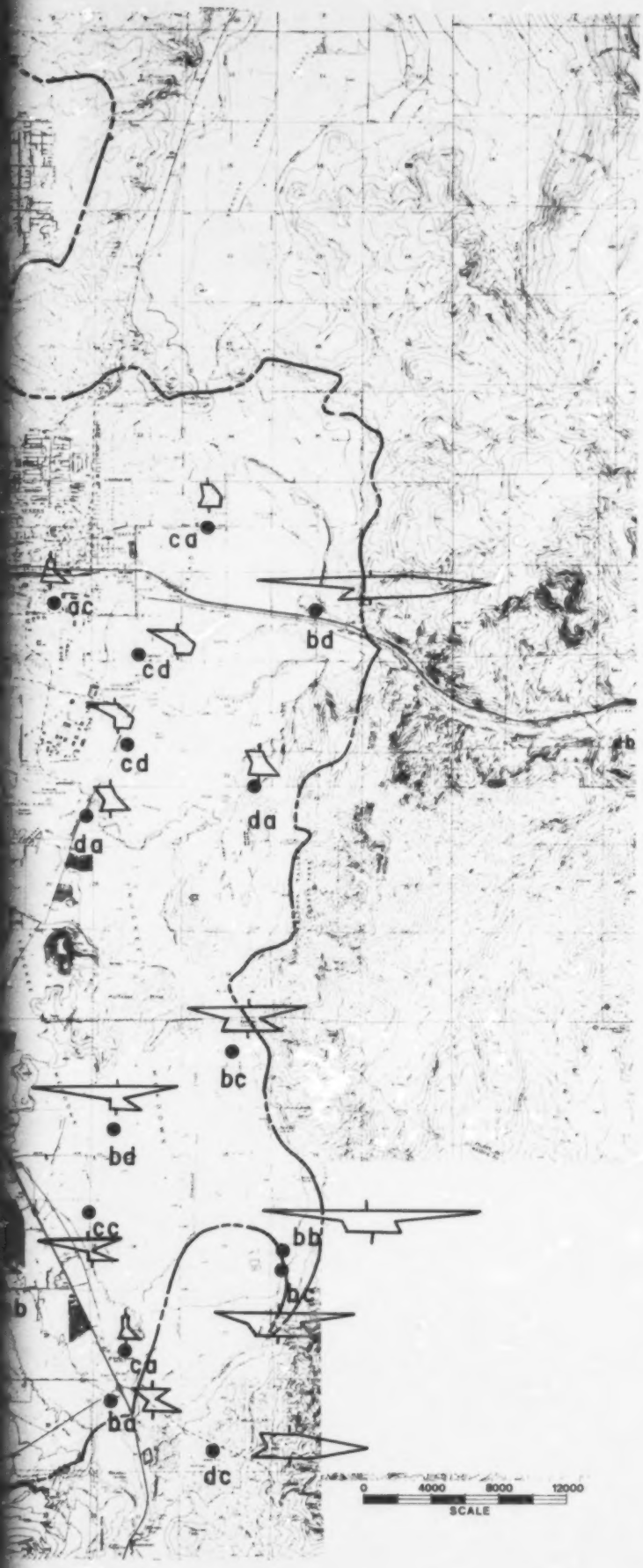
North of the Truckee River, groundwater generally flows to the east. Some of this water, however, does discharge to the Truckee River west of Virginia Street in Reno (Section 11, T.19N, R.19E). East of Virginia Street most of the groundwater discharges to wells, evaporates, or is transpired by plants in the area where the Truckee River flows from the Truckee Meadows area (Sections 10 and 11, T.19N, R.20E) (S-24).

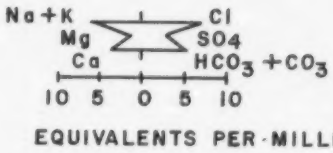
South of the Truckee River and north of the Huffaker Hills, groundwater discharges at one of two general locations. In addition to discharging through several wells, much of the groundwater west of Virginia Street in Reno (Section 11, T.19N, R.19E) discharges either directly to the Truckee River or is transpired by plants along the river shore. Most of the groundwater east of Section 11 generally flows to the east and it is eventually transpired by plants in the area where the Truckee River flows from Truckee Meadows (Sections 14 and 15, T.19N, R.20E), and in the Boynton's Slough area.

- Springs

Although there are numerous springs in the area, the majority of them are small and constitute only a minor fraction of the total groundwater flow. The hot springs area at the northeast base of Steamboat Hills is the exception. These hot springs are the major area of present geothermal activity and add

Reproduced from best available copy.





LOCATION OF WELL SAMPLED. FIRST LETTER REFERS TO THE QUARTER SECTION— SECOND LETTER REFERS TO THE QUARTER-QUARTER SECTION.

GROUNDWATER QUALITY
OF
TRUCKEE MEADOWS

FIGURE 3-8

SOURCE (C-24)

relatively high concentrations of dissolved minerals to both the ground and surface waters. In December 1957, the total spring discharge from this area was 0.7 cfs (C-24).

Lowering of the Potentiometric Surface

Over the last few decades, spring discharges have decreased and artesian pressures in the confined aquifers have declined significantly. In 1945, the cumulative discharge from the hot springs in the Steamboat Springs area was 110 cfs, as measured by the USGS (S-25). By 1957, the cumulative discharge had decreased to 0.7 cfs. Cohen and Loeltz (C-24) reported that, at the time of their report, (1964), there were hundreds of flowing wells in Truckee Meadows. Cooley et al. (C-29) reported that by 1970, only a few wells flowing under artesian pressure were left.

- Groundwater Budget

Groundwater budget information for the Truckee Meadows area is given in Table 3-B.

Spanish Springs Valley

The consolidated rocks in Spanish Springs Valley contain very little water. The alluvial deposits that partially fill the valley are the major source of this area's groundwater supplies. The basal alluvium (approximately 750 feet in thickness), consists primarily of fine-grained, relatively impermeable lake bed deposits with some localized thin beds of coarser material. The surficial alluvium, ranging in thickness from 0 to 400 feet, contains considerably more coarse-grained material, and is considered the major aquifer in the valley (G-5).

Although the exact amount of pumpage from this aquifer is not known, it has been estimated at less than 150 acre-feet per year. Groundwater is primarily used for domestic and stock purposes. Most wells are of small diameter and are equipped with large-capacity pumps. Based on available data, it appears that wells capable of yielding 300 or 400 gpm could be developed in the upper alluvium (G-5).

Preceding page blank

TABLE 3-B

GROUNDWATER BUDGET INFORMATION
FOR THE TRUCKEE MEADOWS AREA[a]

Type of Area	Total Average	Year of Measurement	Annual Recharge Rate (acre-feet)
Recharge			
Urban	--	--	0
Residential	5,543	1971	2,380
Irrigation	15,834	1971	22,570
Open Land	--	--	--
Truckee River[b]	--	1957	4,000
Small Streams	--	1957	<1,000
Underflow from Tributary Valleys	--	1957	1,000
	Total (approximate)		>30,000
Discharge			
Pumpage	--	1947-59	3,000
Underflow	--	1957	<500
Truckee River[b]	--	--	--
Tributary Streams[c]		1957	30,000
	Total (approximate)		>30,000

NOTES: [a] In the preparation of this table, the following quantities of irrigation water from the Truckee River were not accounted for: 1) 1,240 acres west of Lawton; recharge ≈1,500 acre-feet per year; an unknown quantity is transpired by phreatophytes and the rest is discharged into the Truckee River; and 2) 1,133 acres in Spanish Springs Valley; recharge ≈1,400 acre-feet per year; ≈150 acre-feet per year is included in the underflow from "tributary valleys"; the rest is transpired by phreatophytes in Spanish Springs Valley or evaporates.

[b] East of Virginia Street in Reno (Section 11, T.19N, R.19E)

[c] Measurements taken when discharge via transpiration by plants was at a minimum.

Source: (G-5, R-20)

The results of pumping tests on wells 5 and 9 in Spanish Springs Valley (see Figure 3-9), and the Theis non-equilibrium analysis are given below:

	24-Hr. Specific Gravity (gpm/ft. of drawdown)	Transmissibility (gpd/ft.)	Pumping Rate (gpm)
Well 5	15	25,000	600
Well 9	4	7,000	400

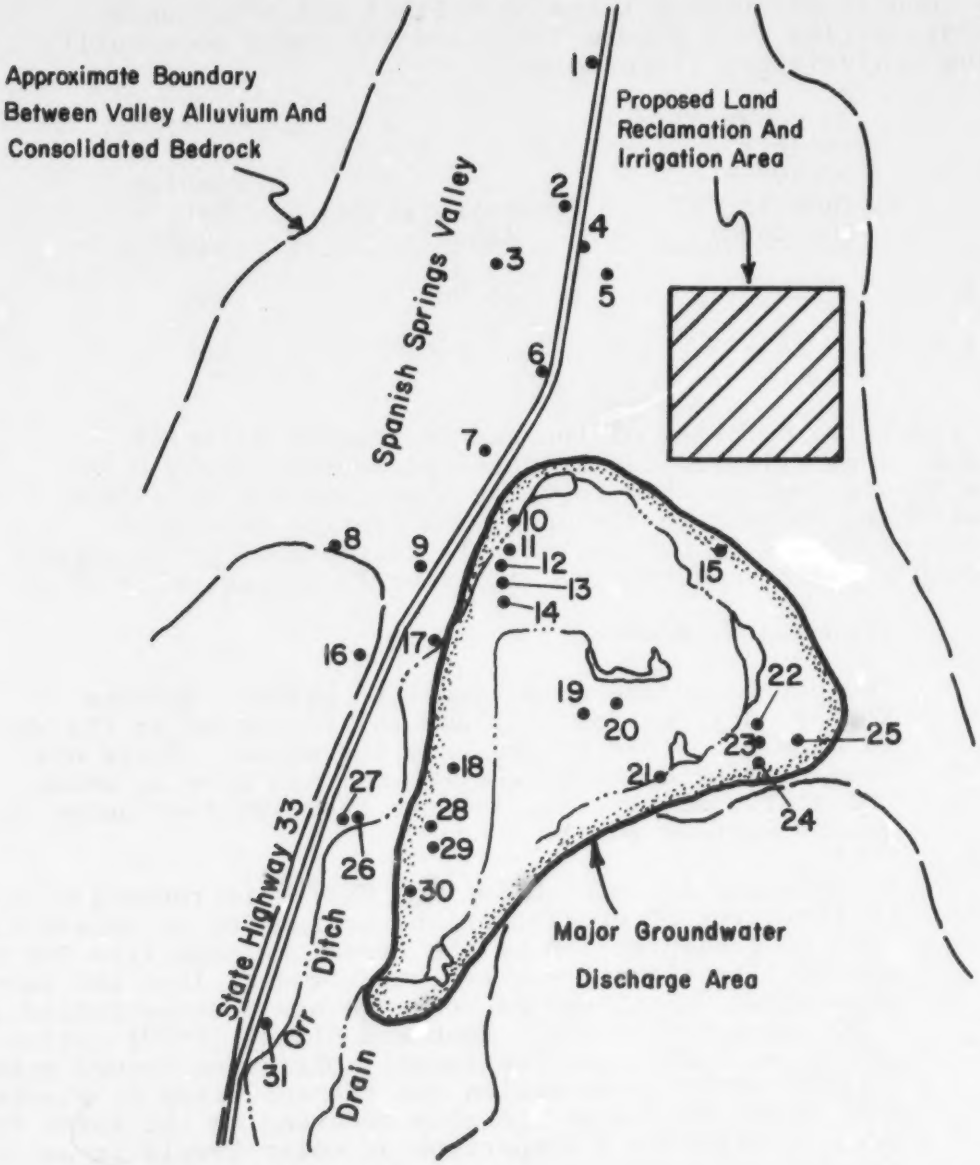
The effective porosity of the coarse-grained material in the upper alluvium is estimated at approximately 0.25. This figure implies that there is about 400,000 acre-feet of water in storage in the upper 200 feet of saturated sediments; 50 to 65 percent of this water could be recovered through properly constructed and properly spaced wells (G-5).

- Groundwater Movement

The depths to the water table in Spanish Springs Valley vary considerably and are reflected in the depths to water recorded in the existing wells. There are some flowing wells in the valley, and some in which the static water level is more than 100 feet below the ground surface (G-5).

Groundwater in Spanish Springs Valley is recharged through infiltration of precipitation, irrigation in excess of the rate of transpiration by the crops, seepage from Orr Ditch, and infiltration of surface water runoff from the surrounding mountains. Total annual recharge has been estimated at about 3,500 acre-feet (G-5). Rush and Glancy (R-20) estimate recharge at 1,000 acre-feet/year. Discharge occurs primarily through direct evaporation and transpiration by plants, with some minor discharge probably occuring to the North Truckee Drain. Based on a comparison of water levels in wells over the last 25 years, recharge rates are roughly equal to discharge rates (G-5).

Groundwater movement in Spanish Springs Valley is generally from north to south. The low alluvial ridge in the northern portion of the valley has little influence on the direction of groundwater movement



GROUNDWATER HYDROLOGY
SPANISH SPRINGS VALLEY

Source: (G-5, R-20)

Figure 3-9

(R-20). The major groundwater discharge area is probably in the southern portion of the valley (see Figure 3-9), due to the shallow water table and the existence of flowing wells.

- Groundwater Quality

The chemical quality of groundwater in the valley varies. In shallow water table areas, (discharge areas), the near-surface groundwater is of poor quality due to the concentration of dissolved minerals through evaporation. In the lower alluvium, the generally poor quality of groundwater is attributable to long residence times and long travel distances through the alluvium. In the recharge zones of the upper alluvium, groundwater quality is generally good (see Figure 3-9 and Table 3-C).

SURFACE WATER QUALITY

Evolution of Water Quality Policy

Truckee River water has been used for industrial, irrigation and water supply purposes for many years. Around 1900 the major polluters consisted of mining and pulp mills (W-1). Wastes from these industries and the feed lots associated with them polluted the river to the degree where it was not suitable for human consumption. The decline of the timber and mining industries resulted in improved Truckee River water quality.

Washoe County experienced a tremendous population growth after World War II (W-1), with the majority of the growth occurring in the Reno-Sparks area. Planning for the development of a regional wastewater management system began in 1962. U.S. Public Health Service surveys (0-4,0-3) indicated significant water quality problems in the Truckee Meadows area due primarily to the Reno and Sparks wastewater treatment facilities. To alleviate these problems, the regional treatment plant, opened in 1967, was located at Steamboat Creek on the eastern edge of Truckee Meadows.

The Federal Water Pollution Control Act of 1965 required each state to establish water quality standards for interstate and coastal waters within each state (E-2, E-3, W-1). Both California and Nevada implemented sampling programs on the Truckee River to provide input to the standard promulgation process (W-1).

TABLE 3-C

CHEMICAL ANALYSES OF WATER FROM WELLS IN SPANISH SPRINGS VALLEY[a]

Well Number[b]	4	5	6	9	9	11	11	13	15	29	31
Depth of Well (ft.)	240	787	855-875[c]	445	848	100	100	117	260	639	580
Total Solids	290	229	660	195	258	744	680	955	286	258	805
Total Hardness, $CaCO_3$	161	165	20	36	44	471	456	649	96	29	213
M.O. Alkalinity, $CaCO_3$	123	120	68	121	116	336	416	324	122	132	76
P. Alkalinity, $CaCO_3$	0	0	0	0	0	0	0	0	0	0	0
Calcium, Ca	48	39	6	9	10	123	120	152	26	9	64
Magnesium, Mg	10	16	1	3	5	40	37	46	8	1	15
Sodium, Na	26	10	218	65	84	50	64	66	86	73	199
Bicarbonate, HCO_3	151	146	83	148	142	410	507	395	149	161	93
Carbonate, CO_3	0	0	0	0	0	0	0	0	0	0	0
Sulfate, SO_4	49	30	255	34	72	180	156	281	43	36	472
Chloride, Cl	30	24	112	14	17	40	9	57	63	12	34
Iron, Fe	Tr.	0.05-	0.05-[d]	0.18	0.1	Tr.	0.3	Tr.	0.72	0.1	0.13
Manganese, Mn	---	0.01-	0.01-	---	---	---	0.01-	---	---	0.05	---
Fluoride, F	---	0.15	2.8	---	---	---	0.05	---	---	0.40	---
Silica, SiO_2	50	22	10	19	---	60	19	78	---	27	8
Free Carbon Dioxide, CO_2	---	5	2	---	---	---	37	---	---	2	---
pH	---	7.62	7.73	7.5	7.4	---	7.3	---	8.2	8.15	---
Specific Conductance at 25°C, (μmho/cm)	---	403	1,097	205	---	---	1,062	---	---	356	790
Temperature (°F)	---	66	80	64	61	---	---	---	---	---	---
Date of Collection	9/12/41	4/15/64	4/21/64	2/29/64	6/25/63	10/20/42	5/9/64	10/20/42	9/2/63	5/9/64	4/16/64

NOTES: [a] Results in ppm except pH and Conductance

[b] See Figure 3-9 for well location.

[c] Interval screened while taking water sample

[d] Iron, Fe 0.6 filtered sample
1.0 unfiltered sample
0.05 coagulated and filtered

Source: (G-5)

In California, the Lahontan Regional Water Quality Board finalized a water quality control policy for Lake Tahoe and the Truckee River (E-2). This policy and the contained water quality standards were approved by the Secretary of the Interior in January 1969.

Nevada published its Interstate Water Quality Standards along with a plan for implementation in 1967 (E-3, W-1). Control points at decreed locations on the Truckee River were established and individual standards were set for each point. Nevada's standards were approved by the Secretary of the Interior in June 1967.

The California State Water Resources Control Board formed a bi-state committee with the Nevada Bureau of Environmental Health to study water quality in the Truckee River Basin (E-2). This committee published a report in 1971 recommending modifications of the general approach for water quality management in the basin. Based on this bi-state committee report, California requested changes in the water quality standards for the Truckee River. This request was not approved by EPA. Amended water quality objectives and standards for California are in preparation as part of the Basin Water Quality Control Plan.

In 1973, the Nevada Environmental Commission adopted new Water Pollution Control Regulations. These new regulations: 1) established a waste discharge permit program; 2) defined water quality standards; 3) established a stream classification system; and 4) classified some waters.

Water Quality Standards

Water Quality Standards under the Nevada Water Pollution Control Regulations of 1973 are summarized below:

- Truckee River

  State standards for the five control points on the Truckee River are summarized in Table 3-D. In general, standards for the Truckee River are designed to protect a high quality stream.

TABLE 3-Da

1973 WATER QUALITY STANDARDS
TRUCKEE RIVER

Parameter	Control Points: Farad	Idlewild	Boynton Lane	Lagomarsino Bridge	Ceresola Ranch
River Mile[a]	86	67	62	57	22
Temperature - °C					
Average					
June through September	Not more than 15	Not more than 17	Not more than 17	Not more than 17	Not more than 18
Summer Single Value	Not more than 20	Not more than 21	Not more than 22	Not more than 22	Not more than 25
Winter Single Value	Not more than 14	Not more than 14	Not more than 14	Not more than 14	Not more than 14
Maximum allowable temperature increase above natural receiving water temperatures	None	Not more than 3	Not more than 3	Not more than 3	Not more than 3
pH Units					
Annual Median	7.3 - 7.9	7.5 - 8.0	7.5 - 8.0	7.4 - 7.9	7.5 - 8.3
Single Value	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
Dissolved Oxygen - mg/l					
Average					
June through September	Not less than 8.0	Not less than 8.0	Not less than 7.5	Not less than 6.5	Not less than 6.5
Single Value	Not less than 7.0	Not less than 7.0	Not less than 7.0	Not less than 6.0	Not less than 6.0
BOD - mg/l					
Single Value	Not more than 5	Not more than 5	Not more than 10	Not more than 10	Not more than10
Chlorides - mg/l					
Single Value	Not more than 8	Not more than 10	Not more than 10	Not more than 10	Not more than 25
Annual Average	Not more than 4				
Phosphates (PO_4) - mg/l					
Annual Average	Not more than 0.1	Not more than 0.1	Not more than 0.25	Not more than 0.5	Not more than 0.75
Single Value	Not more than 0.3	Not more than 0.3	Not more than 0.40	Not more than 0.6	Not more than 1.00
Nitrates (NO_3) - mg/l					
Single Value	Not more than 2.5	Not more than 2.0	Not more than 2.0	Not more than 5	Not more than 5
Annual Average	Not more than 1.0				
Total Dissolved Solids - mg/l					
Annual Average	Not more than 80	Not more than 100	Not more than 125	Not more than 150	Not more than 250
Single Value	Not more than 100	Not more than 125	Not more than 150	Not more than 175	Not more than 300
Boron - mg/l	Not more than 0.3				
Sodium - %	Not more than 40				

Notes: [a] River mile location from Pyramid Lake

TABLE 3-Db

1973 WATER QUALITY STANDARDS
TRUCKEE RIVER
(Continued)

NOTES (Continued):

Color
Shall not exceed that characteristic of natural conditions by more than 10 units Platinum Cobalt Scale

Turbidity
Shall not exceed that characteristic of natural conditions by more than 10 JTU

Fecal Coliform
The more stringent of following apply:

The fecal coliform concentration shall not exceed a geometric mean of 1,000 per 100 milliliters nor shall more than 20 percent of total samples exceed 2,400 per 100 milliliters

The annual geometric mean of fecal coliform concentration shall not exceed that characteristic of natural conditions by more than 200 per 100 milliliters nor shall the number of fecal coliform in a single sample exceed that characteristic of natural conditions by more than 400 per 100 milliliters

Source: (W-1)

- Steamboat Creek

  The Nevada State Environmental Commission classified the upper reaches of Steamboat Creek above Steamboat, Nevada, as Class C waters while the lower reaches are classified as Class D waters. The Reno-Sparks JWPCP discharges to Steamboat Creek just above the confluence with the Truckee River in the Class D section of the Creek. State standards for both Class C and D waters are presented in Table 3-E.

- Pyramid Lake

  There are no water quality standards for Pyramid Lake since the lake lies entirely within the Pyramid Lake Indian Reservation. The State of Nevada Bureau of Environmental Health has no jurisdiction on the reservation.

Water Quality Data

- Data Sources

  Eight agencies have collected water quality data on the Truckee River:

  Desert Research Institute

  Walters Engineering and Metcalf and Eddy Engineers

  Nevada Environmental Protection Services

  U. S. Geological Survey

  U. S. Environmental Protection Agency

  Kaiser Engineers

  Reno-Sparks JWPCP

  U. S. Bureau of Reclamation

  The first long term monitoring program of the Truckee River was initiated by the U. S. Geological Survey (USGS) in 1964 (W-1). The USGS reports chemical and temperature data for the Farad, Wadsworth and Nixon gauges (G-6).

TABLE 3-E

STREAM STANDARDS FOR STEAMBOAT CREEK

Stream Classification	Location: From Headwaters to Steamboat, Nevada (C)	Location: From Steamboat, Nevada To Confluence With Truckee River (D)
1) Floating solids; settleable solids; sludge deposits.	Only such amounts attributable to the activities of man which will not make the receiving waters injurious to fish or wildlife or impair the waters for any beneficial use established for this class.	Only such amounts attributable to the activities of man which will not impair the receiving waters for any beneficial use established for this class.
2) Sewage, industrial wastes, or other wastes.	None which are not effectively treated to the satisfaction of the Commission.	None which are not effectively treated to the satisfaction of the Commission.
3) Toxic materials; oils; deleterious substances; colored or other wastes; or heated or cooled liquids.	Only such amounts as will not render the receiving waters injurious to fish and wildlife or impair the waters for any beneficial use established for this class.	Only such amounts as will not impair the receiving waters for any beneficial use established for this class.
4) pH	Range between 6.5 to 8.5.	Range between 6.0 to 9.0.
5) Dissolved oxygen	For trout waters not less than 6.0 mg/l; for non-trout waters not less than 5.0 mg/l.	Not less than 3.0 mg/l.
6) Temperature	Shall not exceed 20°C for trout waters or 34°C for non-trout waters. Allowable temperature increase above normal receiving water temperature 3°C.	No Standard
7) Fecal coliform	The more stringent of the following apply: the fecal coliform concentration shall not exceed a geometric mean of 1,000 per 100 milliliters nor shall more than 20 percent of total samples exceed 2,400 per 100 milliliters; the annual geometric mean of fecal coliform concentration shall not exceed that characteristic of natural conditions by more than 400 per 100 milliliters. The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10 percent of total samples during any 30-day period exceed 400 per 100 milliliters. This is applicable only to those waters used for primary contact recreation.	
8) Total phosphates	Total phosphates shall not exceed 1.0 mg/l	No Standard
9) Total dissolved solids	Shall not exceed 500 mg/l or one-third above that characteristic of natural conditions (whichever is less).	No Standard

Source: (W-1)

The Nevada Environmental Protection Services initiated a sampling program at five stations in 1966 (W-1). A sixth and seventh station was added at a later date.

The Desert Research Institute began a major monitoring effort on the Truckee River system in 1968 (W-1, D-5). The Truckee River and many of its tributaries are sampled on a monthly basis.

Since 1967 when the plant was placed in operation, the Reno-Sparks JWPCP has routinely monitored the plant effluent.

Several short term water quality studies have been undertaken. Kaiser Engineers sampled at six sites from July to October 1972 (W-1, K-6). The Bureau of Reclamation collected chemical data between 1956 and 1959 (W-1). In 1968, the U.S. Environmental Protection Agency (USEPA) completed a survey of water quality in the Truckee River system. The U.S. Public Health Service completed a 16-day sampling program in 1962 (0-4) and a 12-day program in 1962 (0-3).

- Truckee River Data

Water quality data for the period 1968 through 1974 for six stations in the Truckee River is summarized in Table 3-F. Five of these stations correspond to the state control points for water quality standards. This table presents the mean and standard deviation for the months of February, May, August, and November. As indicated in this table, water quality in the river generally decreases as one moves downstream. This is due primarily to residential, municipal, agricultural and industrial uses (I-1, E-2). The extreme values noted by the Bureau of Environmental Health over the period 1966 through 1975 are given in Table 3-G. Invididual water quality parameters are discussed in the following paragraphs.

TABLE 3-Fa

TRUCKEE RIVER WATER QUALITY

Parameter[b]	Control Point: Farad River Mile 87[a] Feb.	May	Aug.	Nov.	Idlewild River Mile 67[a] Feb.	May	Aug.	Nov.	Boynton Lane River Mile 62[a] Feb.	May	Aug.	Nov.
Temperature, °C, $\bar{x}$	2.4	8.1	16.5	7.6	3.4	9.9	18.3	7.8	3.7	10.6	20.2	8.1
σ	1.6	1.4	2.0	1.3	1.5	1.5	1.8	1.9	1.6	2.1	1.8	2.1
pH, $\bar{x}$	7.74	7.53	7.57	7.70	7.84	7.64	7.91	7.91	7.81	7.69	8.12	8.02
σ	.14	.30	.14	.19	.19	.25	.18	.42	.29	.67	.30	.21
Dissolved oxygen, mg/l, $\bar{x}$	11.2	9.7	8.4	10.0	11.4	9.7	8.9	10.8	11.5	9.61	10.3	11.8
σ	.7	.5	.4	1.5	.9	.5	.6	1.8	1.0	.4	1.3	1.8
Biochemical oxygen demand, mg/l, $\bar{x}$	1.7	1.2	2.0	1.8	1.9	1.3	1.5	2.1	1.7	1.3	2.2	2.2
σ	.8	.4	1.3	.6	.6	.2	.6	.7	.7	.5	1.3	.5
Chlorides, mg/l, $\bar{x}$	5.4	1.5	4.5	5.1	5.1	1.8	5.3	5.2	5.4	2.3	6.0	5.5
σ	2.6	.8	2.6	3.2	2.3	.7	2.9	3.0	2.1	1.1	3.2	3.2
Phosphates Total, mg/l, $\bar{x}$	.06	.05	.09	.11	.08	.08	.11	.10	.08	.09	.11	.14
σ	.04	.03	.06	.11	.02	.03	.02	.10	.03	.04	.05	.16
(PO_4), Ortho, mg/l, $\bar{x}$	.04	.03	.07	.02	.07	.04	.08	.04	.05	.05	.07	.05
σ	.04	.02	.06	.02	.02	.03	.04	.01	.01	.03	.04	.01
Nitrates (NO_3), mg/l, $\bar{x}$	.76	.16	.10	.12	.57	.15	.12	.07	.68	.47	.16	.25
σ	.73	.19	.14	.12	.54	.20	.16	.08	.71	.85	.18	.36
Total dissolved solids, mg/l, $\bar{x}$	73	57	60	75	76	65	72	76	81	61	80	82
σ	16	14	12	12	14	12	6	16	13	21	8	14
Color, $\bar{x}$	7	9	5	6	9	13	7	7	9	15	9	8
Alkalinity, mg/l, $\bar{x}$	48	32	49	50	51	34	52	53	54	37	57	54
Total Coliform, $\bar{x}$	92	18	338	176	83	146	647	164	278	350	1679	702
Fecal Coliform, $\bar{x}$	5	73	2	19	39	6[a]	34	30	59	69	46	14

TABLE 3-Fb

TRUCKEE RIVER WATER QUALITY
(Continued)

Parameter[b]	Control Point: Lagomarsino Bridge River Mile 57[a]				Clarke Station Bridge River Mile 43[a]				Ceresola Ranch River Mile 22[a]			
	Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.
Temperature, °C, $\bar{x}$	3.9	11.2	19.6	7.8	5.2	12.6	23.4	9.8	5.1	14.1	22.1	9.2
σ	1.6	1.6	1.4	1.0	2.4	2.0	1.9	2.1	2.2	2.2	.9	2.2
pH, $\bar{x}$	7.82	7.55	7.77	7.88	7.83	7.58	7.87	7.92	7.83	7.65	7.82	7.99
σ	.21	.52	.14	.16	.25	.47	.21	.21	.26	.58	.11	.12
Dissolved Oxygen, mg/l, $\bar{x}$	10.8	9.3	7.7	10.7	10.6	9.1	7.51	10.6	10.8	9.4	7.9	11.1
σ	.7	.5	.7	1.2	.9	.6	2.0	1.1	.8	1.3	1.1	1.6
Biochemical Oxygen Demand, mg/l, $\bar{x}$	2.1	1.9	3.8	2.6	2.5	2.4	4.2	3.6	2.7	2.1	2.0	2.4
σ	.8	.8	1.0	1.0	.9	1.0	1.5	1.4	.8	.6	1.1	.2
Chlorides, mg/l, $\bar{x}$	13.4	5.4	12.7	13.0	14.3	4.9	14.7	14.3	13.9	6.0	15.0	13.8
σ	6.4	2.3	3.0	7.8	6.4	2.0	3.6	6.9	6.8	3.3	4.2	4.0
Phosphates Total, mg/l, $\bar{x}$	.66	.50	1.74	.82	.85	.42	2.01	1.55	.73	.50	1.07	.77
σ	.13	.21	.85	.26	.25	.15	.70	.77	.22	.11	.20	.74
(PO_4) Ortho, mg/l, $\bar{x}$	.75	.51	1.24	.82	.88	.45	1.92	1.14	.79	.48	.98	.51
σ	.31	.20	.51	.33	.33	.22	.73	.30	.30	.23	.17	.16
Nitrates (NO_3), mg/l, $\bar{x}$	1.23	.88	2.05	1.58	1.66	1.19	3.61	2.75	2.69	1.26	1.59	1.19
σ	1.07	.72	1.34	1.52	.99	1.39	1.85	2.39	1.92	1.05	.54	.53
Total Dissolved Solids, mg/l, $\bar{x}$	126	98	158	143	140	95	167	144	138	114	200	185
σ	36	25	22	22	31	23	23	31	32	39	38	32
Color, $\bar{x}$	19	21	20	12	19	23	25	13	21	21	18	11
Alkalinity, mg/l, $\bar{x}$	75	49	90	80	76	50	94	84	76	60	112	107
Total Coliform, $\bar{x}$	92	1442	5564	477	193	508	5980	1503	265	439	9180	738
Fecal Coliform, $\bar{x}$	9	90	72	11	2	80	261	66	6	51	84	6

NOTES: (a) River Mile Above Pyramid Lake
(b) $\bar{x}$ = Mean
σ = Standard Deviation

Source: (W-1)

TABLE 3-G

EXTREME WATER QUALITY VALUES[a]

Parameter	Farad	Idlewild	Boynton Lane	Lagomarsino Bridge	Clarke Station Bridge	Ceresola Ranch
River Mile[b]	86	67	62	57	43	22
Temperature (°C) - Maximum (May-Oct)	21	22	23	22	26	23
Maximum (Nov-Apr)	8.5	9.5	10	12	12	12
pH - Maximum	8.1	7.55	8.5	8.1	8.3	8.6
Minimum	6.75	6.70	6.5	7.4	6.8	6.6
Dissolved Oxygen (mg/l) - Minimum	7.8	7.5	8.3	6.1	2.0	5.7
BOD (mg/l) - Maximum	2.8	5.8	8.9	5.4	6.5, 7.06	4.7
Chlorides (mg/l) - Maximum	12	10	13	54	55	45
Phosphates (PO_4) (mg/l) - Maximum	.20	.28	.51	2.8	3.00	2.08
Nitrates (NO_3) (mg/l) - Maximum	.7	7.7	6.3	7.7	14	4.0
Total Dissolved Solids (mg/l) - Maximum	92	100	170	208	212	238
Total Coliform (colonies per 100 ml) - Maximum	15,500	4,400	6,600	18,500	20,100	32,900
Fecal Coliform (colonies per 100 ml) - Maximum	149	550	1,170	612	1,340	600

NOTES: [a] Period of Record 1966 - 1975.
[b] River Mile above Pyramid Lake.

Source: (E-19)

Temperature

River temperature tends to increase as one moves downstream. Major temperature increases occur in the Truckee Meadows area, below the Tracy Power Plant, and in the lower reaches below Derby Dam as shown in Figure 3-10. Violations of state temperature standards are common during the summer months downstream from Reno.

BOD - Dissolved Oxygen

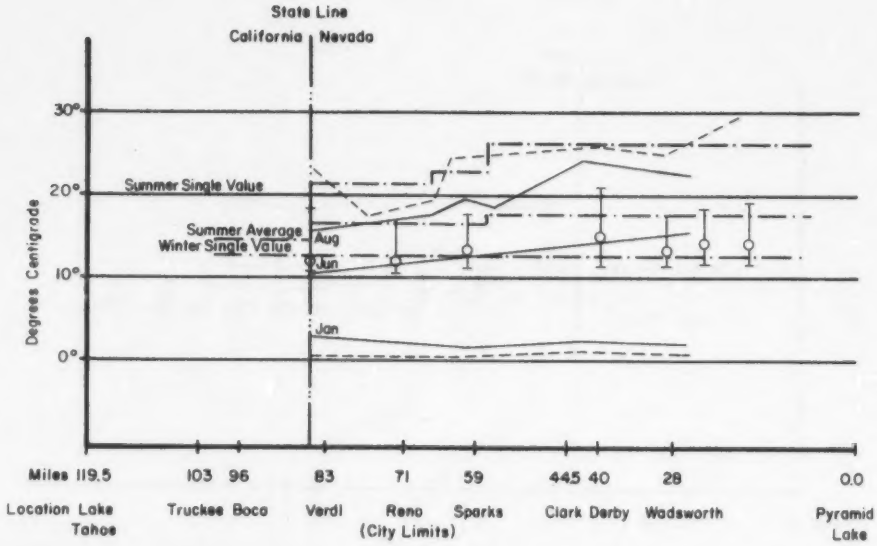
Concentrations of biochemical oxygen demand (BOD) are relatively constant along the Truckee River and are consistently well below state standards. The major source of BOD is the Reno-Sparks JWPCP.

As indicated in Figure 3-11 dissolved oxygen concentrations generally are in compliance with the state average summer minimum standards. However, the single value standard has occasionally been violated at several locations in the river. Many of the single value standard violations are probably due to diurnal fluctuations in temperature and algal activity. Diurnal variations in dissolved oxygen of 3 to 4 mg/l, resulting from temperature and algal activity, have been reported to occur in the Truckee River (W-1). Reported dissolved oxygen violations would probably increase in number if measurements were taken at night.

Nutrients

Ammonia and nitrate concentrations in the Truckee River above the confluence with Steamboat Creek are approximately 0.1 and 0.5 mg/l, respectively. Marked increases in both constituents are observed downstream from Steamboat Creek due primarily to the discharge from the Reno-Sparks JWPCP. Nitrate concentrations in the river are below state standards as shown in Figure 3-12. Although there are no standards for ammonia, concentrations have been reported between 0.00 and 0.99 mg/l at Lockwood during the water year October 1974 to September 1975. Much of this ammonia is thought to be attributable to the Reno JWPCP.

Historical data which illustrates the spatial variations of total phosphate concentrations in the river is presented in Figure 3-13. The state standard has been exceeded at all points in the river, particularly below Boynton Lane. The major contributors are the North Truckee Drain and Steamboat Creek (W-1).



-KEY-

Maximum, Mean & Minimum From Kaiser Data, Aug-Oct, 1972

Jan
Jun
Aug
Nevada Bureau of Environmental Health Mean Monthly 1966-1974

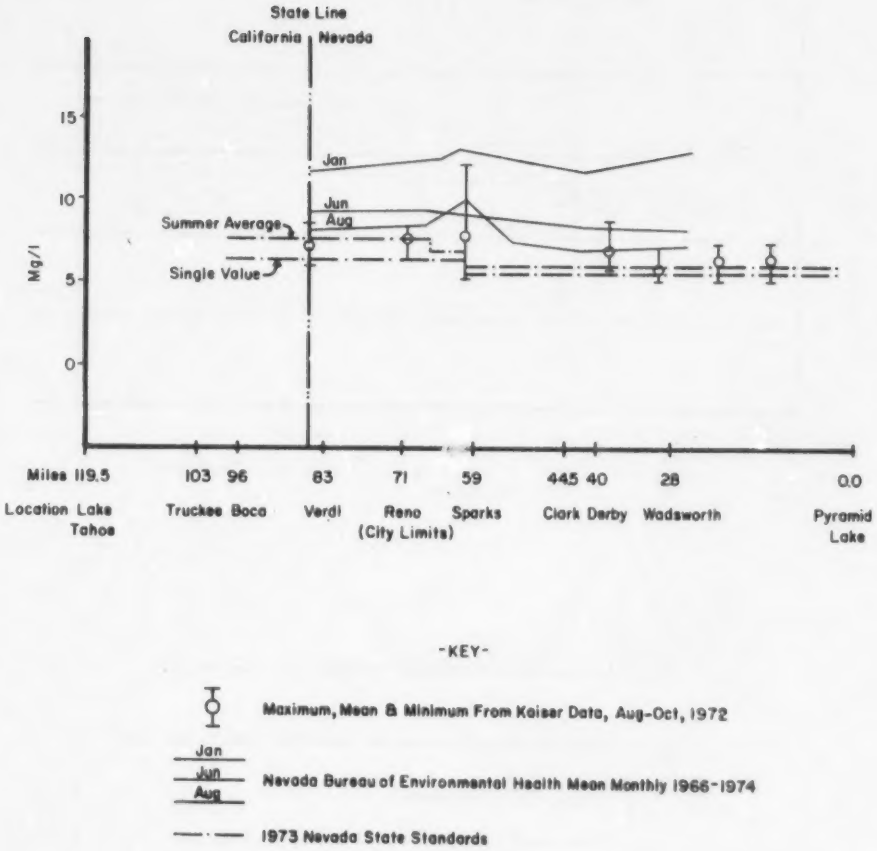
1973 Nevada State Standards

Desert Research Institute 1968-1973, Minimum & Maximum

TEMPERATURE

Source: (W-1)

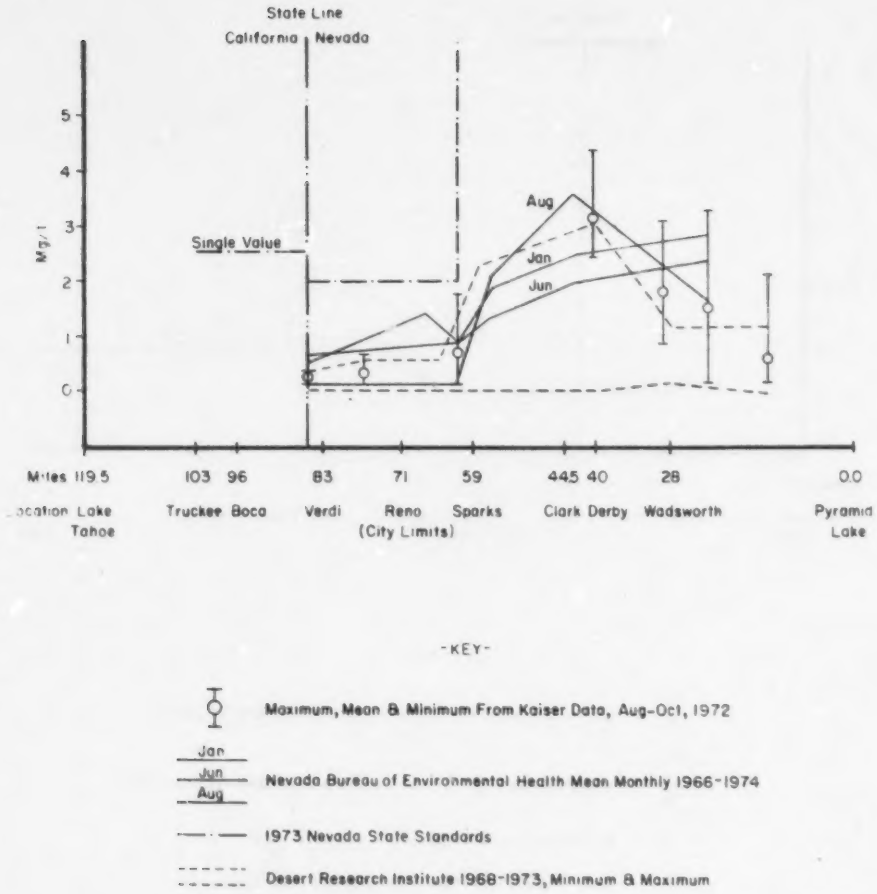
Figure 3-10



DISSOLVED OXYGEN

Source: (W-1)

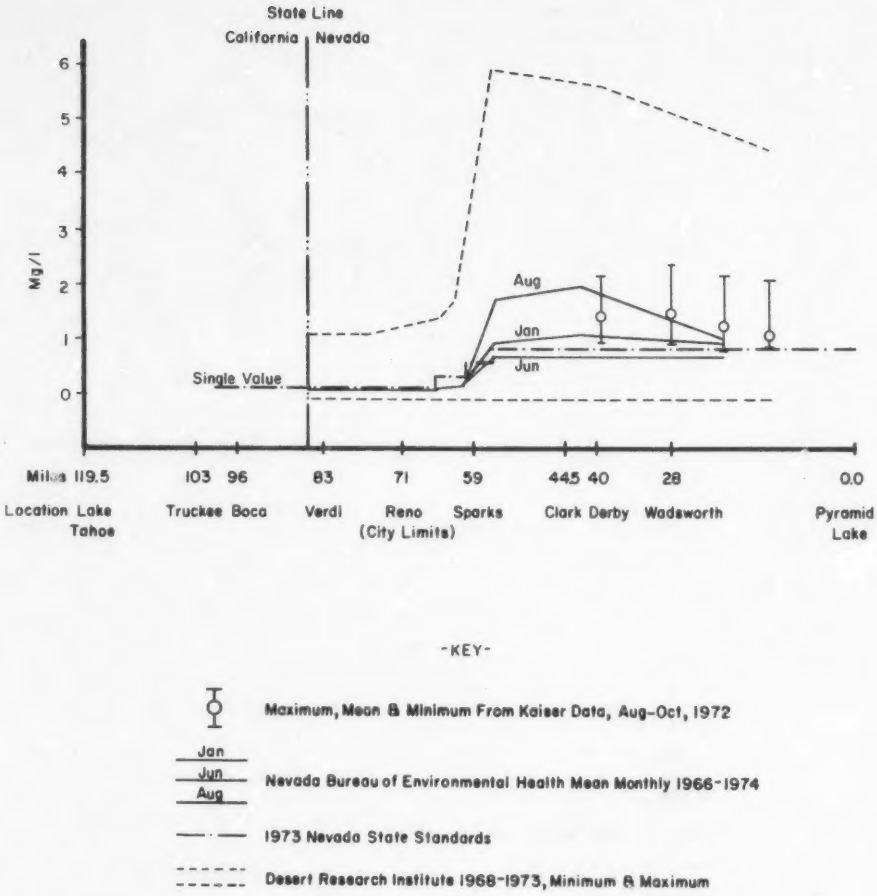
Figure 3-11



NITRATES

Source: (W-1)

Figure 3-12



TOTAL PHOSPHATES

Source: (W-1)

Figure 3-13

Dissolved Materials

Total dissolved solids (TDS) concentrations in the Truckee River exceed the state standard in the reaches just downstream of Reno and Sparks, as well as in the reaches below the Ceresola Ranch control point at river mile 22 (W-1). The variation in TDS can be seen in Figure 3-14. The major contributors of TDS are Steamboat Creek and the North Truckee Drain.

The state standard for chlorides has been exceeded on occasion at virtually all points in the stream. Chloride concentrations generally increase progressively downstream of Reno-Sparks. Major contributors of chlorides are irrigation-return water and the Reno-Sparks JWPCP effluent.

Concentrations of heavy metals in the Truckee River are relatively low. McBrayer and Ringo (M-2) reported lead concentrations of less than 0.002 mg/l; iron levels of 0.03 to 0.15 mg/l; zinc concentrations of 0.014 to 0.100 mg/l; and chromium levels of less than 0.1 mg/l.

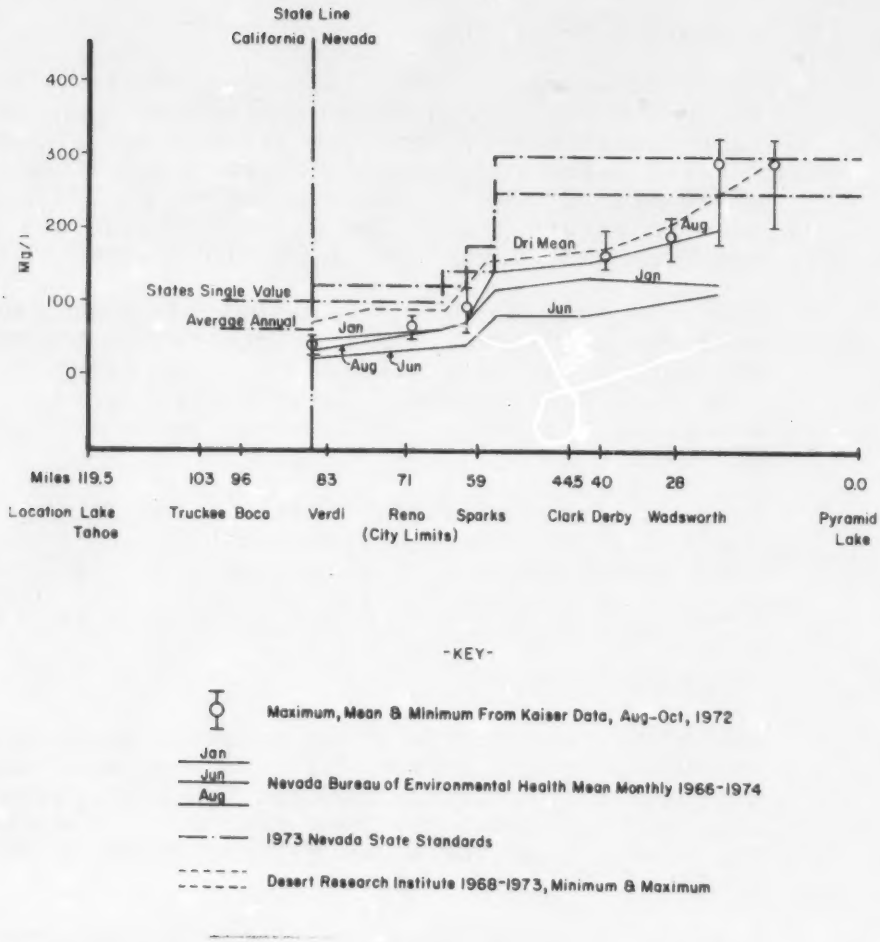
Other Constituents

The pH of the Truckee River normally meets state standards, ranging from 7.5 to 8.0 in most studies. Only the single value standard has been exceeded, and then, only in the lower reaches of the river, particularly at the Nixon Station at river mile 14 (W-1).

Concentrations of fecal coliforms in the river are well below the state standard of 1,000 organisms per 100 ml. Observed values normally range from 0 to 300 per 100 ml (W-1).

The sodium adsorption ration (SAR) is low, indicating the river's suitability for irrigation. The SAR is approximately 1.0 (I-1).

Kaiser Engineers (K-6) reported relatively low turbidities in the California sections of the Truckee River with means reported at Kaiser's six stations ranging from 0 to 1.7 JTU. Their data indicated that turbidity increased to a high of 20.7 JTU downstream from Steamboat Creek. USGS data show turbidities from 2 to 20 JTU at Lockwood (mean = 5 JTU), and 1 to 300 JTU (mean = 24 JTU) at Farad.



TOTAL DISSOLVED SOLIDS

Source: (W-1)

Figure 3-14

Glancy, et al. (G-7) reported on suspended sediment levels in 1969. This was a high-flow year, resulting in significant increases in stream sediment loads and erosion. The largest suspended solids observation made by the USGS at the Nixon Station was 2,400 mg/l. Suspended solids averaged 430 mg/l during the year, indicating an annual sediment load in Pyramid Lake of about 570,000 tons. It is interesting to note that over 99 percent of the annual sediment load passed the Nixon gauge during only 47 percent of the year.

- Steamboat Creek Data

Results of a single sampling of water quality in Steamboat Creek by the Nevada Environmental Protection Services in February 1974 are presented in Table 3-H. The dissolved oxygen, pH, BOD, and nitrates remain fairly constant along the stream, while an increase in phosphates, temperature, flow, and coliforms are noted in the reach immediately above the confluence with the Truckee River. This is due primarily to the discharge from the Reno-Sparks JWPCP.

Steamboat Creek's water quality near the confluence with the Truckee River is summarized in Table 3-I. This table presents data for stations on Steamboat Creek immediately upstream and downstream of the Reno-Sparks JWPCP for both January and August. The data represents a long term (1968-1975) sampling program conducted by the Desert Research Institute. It is apparent that the JWPCP's effluent tends to increase the stream's temperature and nitrate concentrations.

Water quality data for the Truckee River both above and below the confluence with Steamboat Creek is also presented in Table 3-I. The North Truckee Drain and Steamboat Creek tend to increase the temperature, conductivity (which also implies an increase in TDS), chloride, and nitrates in the river.

- Pyramid Lake Data

The relatively steady decline in lake level has resulted in increased salinity levels in Pyramid Lake. Concentrations of total dissolved solids have increased from approximately 3,300 mg/l in the 1860's to

TABLE 3-H

STEAMBOAT CREEK WATER QUALITY, FEBRUARY 1974 [a]

Parameter	Washoe Lake Outlet to Steamboat Creek (SB1)	Andrews Lane and Steamboat Creek in Pleasant Valley (SB3)	Highway 17 and Steamboat Creek (SB5)	Pembroke Lane and Steamboat Creek (SB7)	Kimlick Lane Bridge and Steamboat Creek[b] (SB8)	Mouth of Steamboat Creek at Truckee River[c] (SB9)
Temperature (°C)	3.0	6.0	11.0	5.5	5.5	10.0
pH	8.1	8.3	8.1	8.3	8.3	8.1
Dissolved Oxygen (mg/l)	10.7	11.9	10.0	---	13.1	10.9
BOD_{5-20} (mg/l)	1.2	2.1	1.1	2.3	4.6	4.0
Chloride (mg/l)	9	9	163	91	83	64
Phosphates as PO_4						
Total (mg/l)	0.79	0.28	0.80	0.62	0.55	7.3
Ortho (mg/l)	0.54	0.24	0.80	0.62	0.53	6.8
Nitrates as NO_3 (mg/l)	2.2	1.2	2.5	2.4	1.9	1.7
Total Dissolved Solids (mg/l)	224	187	574	486	416	360
Turbidity (JTU)	4.8	4.8	5.4	0.6	0.6	6.0
Coliforms (colonies per 100 ml)						
Total	40	250	290	170	500	700
Fecal	< 2	2	18	20	14	40
Flow (cfs)	0.89	5.34	8.6	43.7	53.5	8.3

NOTES: [a] University Drain & Agricultural return flows center Steamboat Creek between SB7 and SB8.
[b] Main stream above Reno JWPCP.
[c] Main stream approximately 0.2 miles downstream of Reno JWPCP at confluence of Truckee River.

Source: (E-18)

TABLE 3-I

WATER QUALITY IN STEAMBOAT CREEK NEAR CONFLUENCE WITH THE TRUCKEE RIVER[a]

Parameter	January				August			
	Steamboat Creek		Truckee River		Steamboat Creek		Truckee River	
	Above STP	Below STP	Above Steamboat Creek[b]	Below Steamboat Creek[c]	Above STP	Below STP	Above Steamboat Creek[b]	Below Steamboat Creek[c]
Temperature, °C	0.8	5.3	1.5	1.6	20.2	21.2	18.6	19.7
pH	7.8	7.6	7.4	7.4	7.5	7.1	7.5	7.4
Conductivity (μmho/cm)	692	624	104	185	307	349	104	190
Chloride (mg/l)	83	65	5	12	17	22	3	7
Nitrate (as NO_3)(mg/l)	2.3	5.7	0.7	1.6	0.9	4.3	0.4	1.7

NOTES: [a] For period of record January 1970 - January 1975
[b] At Boynton Lane Control Point, River Mile 61.6
[c] At Vista Station, River Mile 57.8
Steamboat Creek is located at River Mile 59.0

Source: (D-5)

about 5,200 mg/l in 1975 (I-1). The pH of the lake is about 9.1 to 9.2 (I-1, W-10). Turbidities are relatively high due to the abundance of plankton and high concentrations of salts (I-1).

The summer surface water temperature is about 75°F while the temperature at a depth of 50 feet is only 54°F. During the winter, water temperatures are fairly uniform at about 42°F from surface to bottom (I-1).

Dissolved oxygen concentrations during the winter are about 7.5 mg/l at the surface and 7.0 mg/l at a depth of 200 feet. Water quality reported by Koch, et al. (K-5) is shown in Table 3-J.

An extensive water quality monitoring program of Pyramid Lake was initiated in January of 1975 by William F. Sigler and Associates, Inc. and sponsored by the Bureau of Indian Affairs. Selected results of the January and February samplings which were taken from three mid-lake stations at various depths are presented in Table 3-K. The three stations are located approximately 5, 20 and 30 kilometers from the mouth of the Truckee River on the central longitudinal axis of the lake.

Future Water Quality Objectives

Water quality standards are subject to change; they may be revised, added or even deleted. Ideally, a standard should be designed to protect a given water use, with a safety factor built in to account for uncertainty. As scientific knowledge expands, the standard should be modified to reflect the current state of knowledge concerning that particular substance.

The State of Nevada may consider additions of standards for ammonia, total nitrogen, toxic materials, pesticides, heavy metals and radioactivity. If standards were to be adopted for toxic materials, pesticides, and heavy metals, they could take the form of limitation on individual materials such as cyanide, mercury, copper, and endrin. For river reaches designated for public water supply, all or part of the U.S. Public Health Service drinking water standards could easily be adopted for use as water quality standards.

TABLE 3-J

WATER QUALITY IN PYRAMID LAKE

Parameter	Location			
	Middle Surface	South Surface	Middle Surface	Middle 10 m
Date	7/73	6/74	6/74	6/74
Conductivity (μmho/cm)	9890	7800	7950	7800
pH	8.9	8.9	9.0	8.9
Chloride (mg/l)	2010	2010	1980	2030
Sulfate (mg/l)	271	257	261	257
Nitrate (as NO_3)(mg/l)	0.05	0.04	0.05	0.04
Phosphate (as PO_4) (mg/l)	0.20	0.08	0.07	0.08
Calcium (mg/l)	5.9	7.6	7.5	7.6
Sodium (mg/l)	1630	1583	1526	1583
Potassium (mg/l)	105	112	137	113
Magnesium (mg/l)	105	111	119	111
TDS (mg/l)	5317	5168	---	---

Source: (K-5)

TABLE 3-K

WATER QUALITY ANALYSIS OF PYRAMID LAKE

Parameter	Station Depth (m)	I,2 1	I,2 20	I,2 50	II,2 1	II,2 40	II,2 80	III,2 1	III,2 40	III,2 80
January 1976										
pH		9.21	9.19	9.20	9.21	9.18	9.16	9.20	9.20	9.20
Specific conductance @25°C		8,400	8,800	8,750	8,600	8,750	8,450	8,450	8,300	8,750
Bicarbonate - HCO_3		1,430	1,416	1,432	1,424	1,424	1,424	1,421	1,417	1,426
Chloride - Cl		1,956	1,941	1,972	1,941	1,909	1,925	1,956	1,909	1,956
Sulfate - SO_4		330	282	279	275	266	270	268	278	276
Sodium - Na		1,607	1,607	1,619	1,607	1,607	1,632	1,607	1,607	1,624
Potassium - K		108	108	104	103	106	104	104	103	104
Magnesium - Mg		111	113	113	112	113	113	112	111	112
Silica - SiO_2		0.98	1.0	1.0	0.95	0.90	1.3	1.0	0.98	1.15
TDS (evap. @180°C)		4,710	4,360	4,824	4,828	4,648	4,828	4,604	4,840	4,740
Nitrate - NO_3		0.31	0.25	0.27	0.29	0.37	0.46	0.23	0.29	0.37
Orthophosphate (PO_4)		0.31	0.31	0.28	0.31	0.31	0.34	0.28	0.28	0.31
Total phosphate		0.09	0.09	0.10	0.09	0.09	0.11	0.11	0.10	0.11
February 1976										
pH		9.25	9.26	9.23	9.23	9.27	9.23	9.25	9.22	9.28
Specific conductance @25°C		8,250	8,370	8,250	8,250	8,250	8,370	8,100	8,150	8,250
Bicarbonate - HCO_3		1,493	1,493	1,484	1,443	1,462	1,468	1,402	1,421	1,443
Chloride - Cl		2,046	1,994	1,946	1,994	2,010	2,010	1,945	1,898	2,010
Sulfate - SO_4		277	278	276	274	272	267	255	261	269
Sodium - Na		1,630	1,595	1,600	1,595	1,595	1,600	1,505	1,570	1,595
Potassium - K		100	95	94.6	94.6	95	94.6	87	94	94.6
Calcium - Ca		7.18	7.01	6.92	7.18	6.96	6.74	7.41	7.05	6.74
Magnesium - Mg		115	114	114.6	115	116	115	108	112	110
Silica - SiO_2		0.8	1.6	0.9	0.9	1.1	2.3	1.5	1.0	0.8
TDS (evap. @180°C)		5,004	5,088	5,064	4,916	4,908	5,008	4,820	4,680	4,564
Nitrate - NO_3		0.23	0.23	0.25	0.23	0.20	0.76	0.30	0.26	0.49
Nitrite - NO_2		0.007	0.010	0.008	0.007	0.005	0.017	0.011	0.012	0.008
Ammonia - NH_4		<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Kjeldahl nitrogen		0.84	0.83	0.92	0.99	0.90	0.86	0.86	0.86	0.81
Orthophosphate (PO_4)		0.25	0.25	0.25	0.25	0.25	0.43	0.28	0.25	0.25
Total phosphate		0.09	0.10	0.10	0.10	0.09	0.14	0.10	0.09	0.09

Source: (S-28)

The Water Pollution Control Act Amendments of 1972 (Public Law 92-500) require that no future degradation of water quality be allowed. This appears to dictate that current Nevada standards for the Truckee River cannot be made less stringent since the standards were set partially on the basis of existing stream quality. However, wastewater treatment technology reflecting best practicable technology and best available technology may serve to reduce concentrations of various constituents well below current water quality standards.

EXISTING REGIONAL SEWERAGE FACILITIES

Based upon the technical familiarity of various engineering firms with elements of the regional sewerage facilities which collect, transport, treat, and discharge the wastewater of the service area, the following sources have been quoted in the section below:

Regional Water Pollution Control Plant - Kennedy Engineers

Sewer Service Areas Tributary to the Regional Plant - Truckee Meadows Engineers

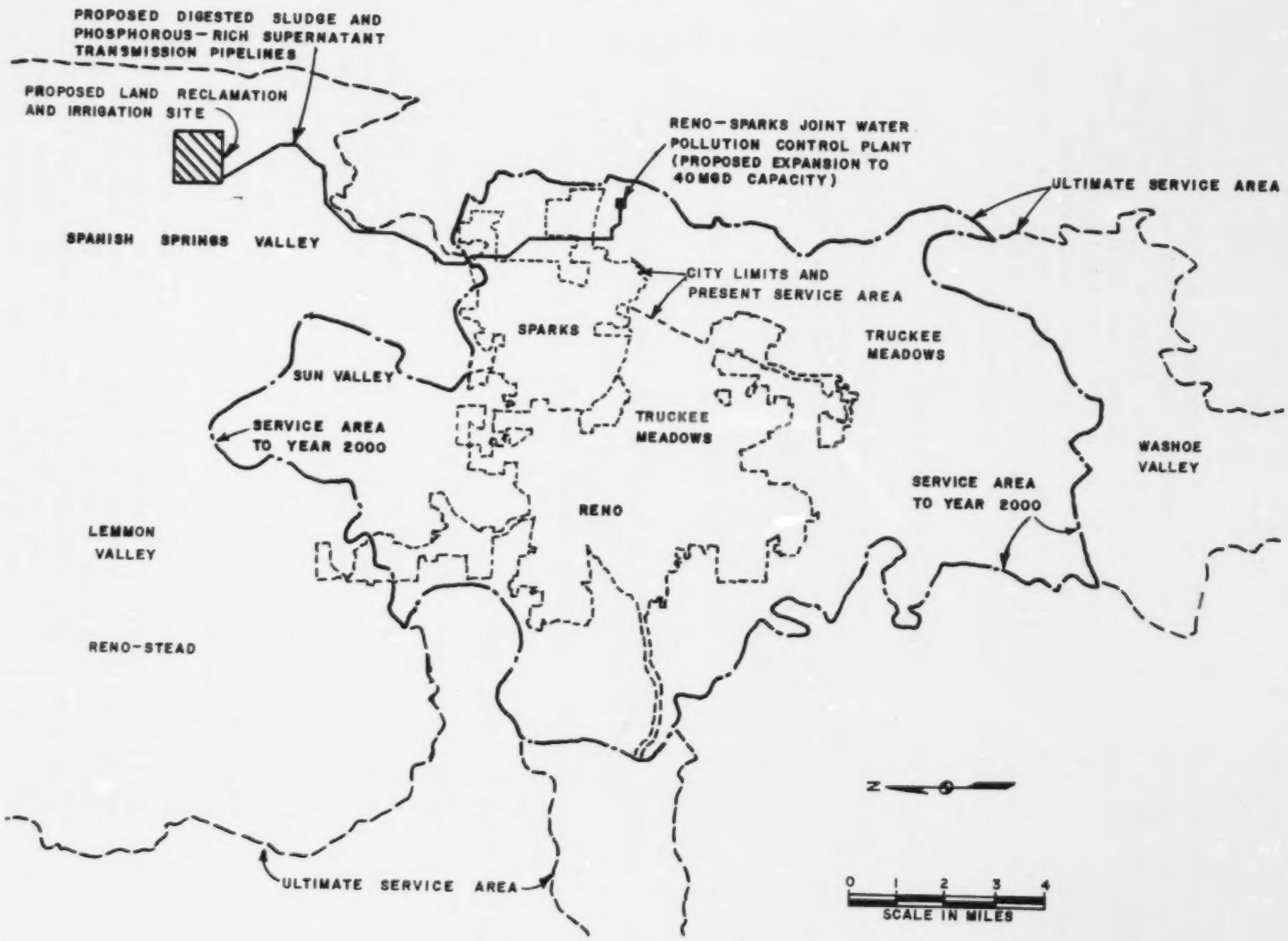
Local, Self-Contained Sewerage Systems - Walters Engineers

Reno-Sparks JWPCP (K-1)

- Location, Service Area and Collection Systems

The Reno-Sparks JWPCP is located in Truckee Meadows. Effluent from the facility is discharged into Steamboat Creek which in turn discharges to the Truckee River. The location of the treatment plant in relation to the major cities of the area is shown in Figure 3-15. The area currently served by the Reno-Sparks JWPCP is primarily within the city limits of Reno and Sparks and covers approximately 37 square miles.

The plant is jointly owned by the Cities of Reno and Sparks. Sparks is responsible for the operation and maintenance of the plant, and costs are allocated the basis of flow from each entity. The Cities of Reno and Sparks own and maintain separate collection systems. After the construction of the joint plant, interceptor sewers were constructed to convey flow from the two systems to the treatment plant. These



EXPANSION OF RENO/SPARKS
JWPCP REGIONAL SERVICE AREA

Source: (K-1)

Figure 3-15

interceptors are jointly owned by the Cities of Reno and Sparks and are maintained by the City of Reno.

Reno's collection system consists of about 285 miles of sewers. Sewer sizes range from 8 to 24 inches, with interceptors up to 72 inches in diameter. Sewers and pump stations are maintained and routinely inspected by the City of Reno. A major characteristic of the Reno collection system is the existence of combined sewers in the older section of the system. The city is currently engaged in a sewer separation project which will eliminate the combined system.

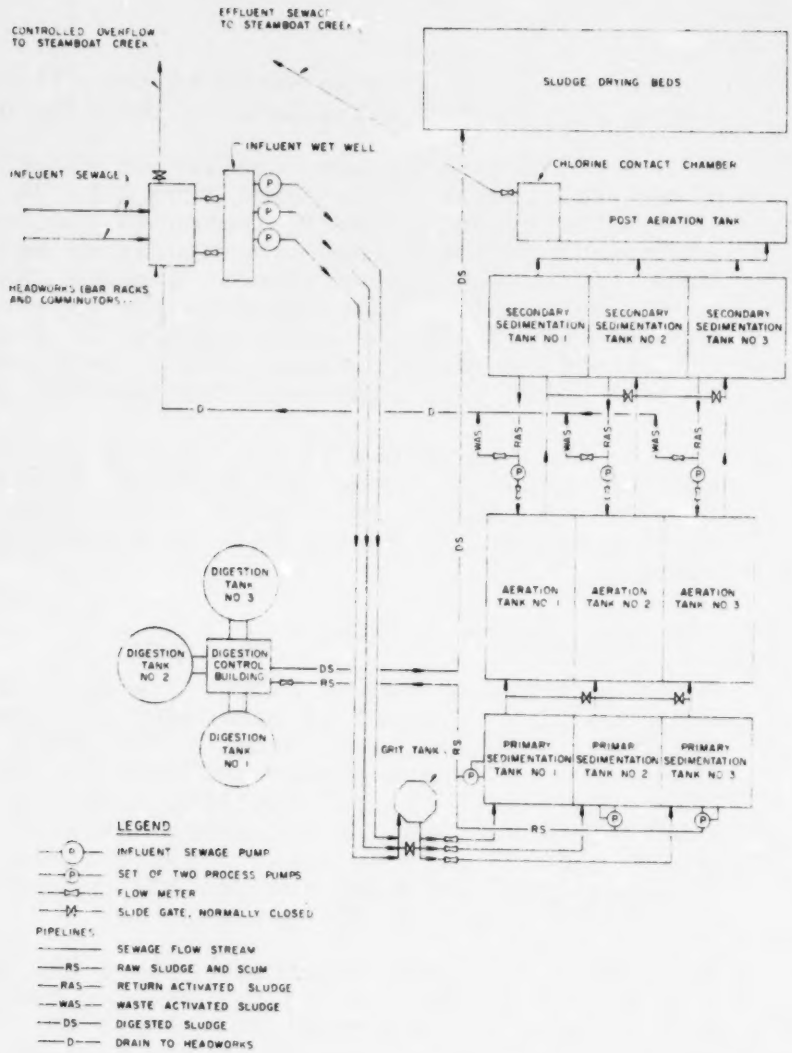
The City of Sparks has an existing collection system which consists of about 100 miles of sewers ranging from 8 to 36 inches in diameter. The sewer separation project undertaken by the City of Sparks is nearly complete.

- Design of Existing Plant

The existing Reno-Sparks JWPCP is a secondary treatment facility, typical of many used throughout the country. A schematic diagram of the plant is presented in Figure 3-16. Raw sewage influent to the plant is pumped to a grit chamber facility. As the sewage enters this facility, a screening device removes coarse objects such as rags, plastic items, etc. The actual grit chamber removes the coarse and easily settled materials in the sewage.

The primary treatment facility allows the settling of much of the solids. Since the driving force is gravity, this process is economical and simple to operate. Moreover, it removes approximately 60 percent of the settleable solids and up to 60 percent of the BOD from the sewage.

The secondary treatment process, which receives the effluent supernatant from the primary process, vigorously aerates the sewage. This induces the metabolism of organic materials by micro-organisms that are present and flourishing. During the final stages of secondary treatment, these organisms are settled from the liquor. The effluent supernatant is then aerated (to introduce oxygen into it), disinfected with chlorine to remove any remaining pathogenic organisms, and discharged.



SCHEMATIC DIAGRAM
RENO-SPARKS JWPCP

Source: (K-1)

Figure 3-16

In the past, frothing problems have been experienced in both the aeration/settling systems and in Steamboat Creek. Frothing is caused by the high solids levels in the activated sludge process. These problems have been controlled by process modifications, such as maintaining lower organism levels than normal in the secondary aeration treatment stage. Despite the inherent difficulties in this procedure, the plant has been operated efficiently and produces an excellent quality effluent.

In both the primary and secondary processes, settling was utilized to remove heavy materials. This created sludges, which require treatment processes for adequate and safe disposal. The primary sludge, with a portion of the secondary sludge, is transported directly to the anaerobic digestion stage. The remaining secondary sludge is returned to the aeration process described above. Under these anaerobic conditions (viz - without oxygen), the organic material is reduced in volume by a fermentation process. This produces methane, a combustible gas, which is disposed of by burning. Some of the heat generated in burning is used to maintain the process; the remainder is wasted. The digested sludge is then piped to the sludge drying beds located between the plant and the Truckee River. These beds function to allow drying of the sludge by natural means, but in recent years have encountered two operational problems. The sludge from the digestors has a much lower solids content (2 to 3 percent) than originally anticipated (6 percent). This could well be a consequence of the particular mode of operation of the aeration chambers and the effects on sludge produced. The second problem pertains to the actual location of the sludge drying beds. They are located in the floodplain of the Truckee River and, consequently could be flooded. This is considered a health risk by the Washoe County Department of Health which has ordered that all drying beds within the floodplain be removed by 1978.

- Performance and Costs

The Reno-Sparks JWPCP has an excellent record in BOD and suspended solids removal. Based on 1973, 1974 and 1975 plant monitoring data, BOD and suspended solids

removals exceed 90 percent. The 1974 operational and maintenance costs for the Reno-Sparks JWPCP is estimated at $97 per million gallons of wastewater treated.

- Wastewater Treatment and Discharge Requirements

On January 10, 1975, the EPA issued National Pollutant Discharge Elimination System (NPDES) Permit No. NV0020150 which established requirements for the Reno-Sparks JWPCP effluent discharged to the Truckee River. NPDES permit discharge requirements for the expanded plant (40 MGD) are given in Table 3-L.

TABLE 3-L

NPDES PERMIT DISCHARGE REQUIREMENTS

Effluent Characteristics	Discharge Limitations	
	30-Day, Avg.	7-Day, Avg.
BOD (5-day, 20°C) (mg/l)	10	15
Suspended Solids (mg/l)	20	30
Total Phosphorus (PO_4) (mg/l)	3.0	4.5
Total Phosphorus (P) (mg/l)	1.0	1.5
Fecal Coliform Bacteria (ml)	200/100	400/100
Dissolved Oxygen	Greater than 6.0 mg/l at all times	
pH	Within range 6.5 to 8.5 at all times	

Source: (K-1)

Sewage, Flows and Loading (K-1)

The present average annual wastewater flow to the Reno-Sparks JWPCP is approximately 18 MGD. However, average monthly flows during July and August of 1973 and 1974 ranged from 19 to 20 MGD. Since the plant must be capable of treating prolonged peak summer flows associated with peak tourist activity, it should be assumed that the combined wastewater flow from the Cities of Reno and Sparks has reached the 20 MGD design capacity of the existing plant. Characteristics of the wastewater entering the Reno-Sparks JWPCP are within ranges considered typical for domestic wastewater. Average values of the wastewater characteristics during 1973 are given in Table 3-M.

TABLE 3-M

WASTEWATER CHARACTERISTICS
(average values for 1973)

	Plant Influent	Plant Effluent
BOD (mg/l)	174	6
Suspended Solids (mg/l)	263	12
Orthophosphate as P (mg/l)	6.9	6.6
Nitrate as NO_3 (mg/l)	2.1	4.5
Dissolved Oxygen (mg/l)	2.1	8.0
pH	7.5	7.4
Temperature (^oF)	65	-

Source: (K-1)

Based on the above values and a flow rate of 20 MGD, approximate loadings in pounds per day of significant parameters to the JWPCP are as follows: BOD, 29,000; suspended solids, 44,000; orthophosphate as P, 1,150; nitrate as NO_3, 350.

Existing Sewer Service Areas and Trunks

Advance planning of sanitary sewage facilities in the Reno-Sparks area has been undertaken to "keep in step" with growing urbanization patterns. To aid in the understanding of future sewerage service, a brief description of the existing sewer service areas and their grouping into tributary areas for the major interceptor sewers is presented herein.

The City of Reno, in 1975, prepared a map entitled "Sanitary Sewer System", showing in detail all existing local collection systems, trunk sewers, and interceptor sewers. Flow patterns of local collectors, and trunk sewer systems lead directly to establishment of areas tributary to major interceptors. These tributary areas are numbered (see Table 3-N) and their relationship to existing sewer service zones are shown on Figure 3-17.

The allotment of sewage flow from Reno and Sparks to the existing Reno-Sparks JWPCP deserves consideration because the quantity of sewage from the municipalities is the basis for proportioning quarterly operating costs between Reno and Sparks. A metering system has been established to record flow quantities and is discussed in a susbsequent section of this chapter.

- Cross-Town Sewer

  The Cross-Town Sewer has been constructed in stages, over the last 50 years. Cross-Town Line 8 (constructed before 1930) and Cross-Town Line 1 (constructed between 1930 and 1965) are the primary elements of this system.

  The Cross-Town Sewer serves Areas 1, 3 and 7, approximately 3,500 acres, as shown on Figure 3-17. The sewer currently collects flows from the Dickerson Road Interceptor, Peavine Mt. Interceptor and Northwest Interceptor. Examination of 1974 Cross-Town Sewer flows. Table 3-M indicates that reaches of the existing Cross-Town system are currently carrying 71 percent of design capacity. These sections are inadequate to handle projected 1995

TABLE 3-N

SERVICE AREAS

Major Interceptor	Service Area
Cross-Town Sewer	1
Line 1 Line 8	
North Reno Interceptor	2
Northwest Interceptor	3
North Truckee Meadows and Sparks	4
Project 1 Project 2 Project 3	
South Truckee Meadows Interceptor	5
Mill Street Interceptor	6
Peavine Mountain Interceptor	7
Spanish Springs Interceptor	(not defined)
Dickerson Road Interceptor (Initial Stage of Lawton-Verdi Interceptor)	

sewage flows unless relieved of the need to serve the tributary areas west of Arlington Avenue. With completion of the proposed Cross-Town Interceptor and diversion of the Dickerson Road Interceptor and the Northwest Interceptor to this new facility, the existing Cross-Town Sewer has adequate capacity to serve the central downtown Reno area through the 1995 planning horizon. A comparison of existing flow, ultimate flow, and design flows is presented in Table 3-O.

- North Reno Interceptor

  The North Reno Interceptor is located north of Highway I-80. It begins west of Ralston Street and flows in an easterly direction to the North Truckee Meadows Interceptor.

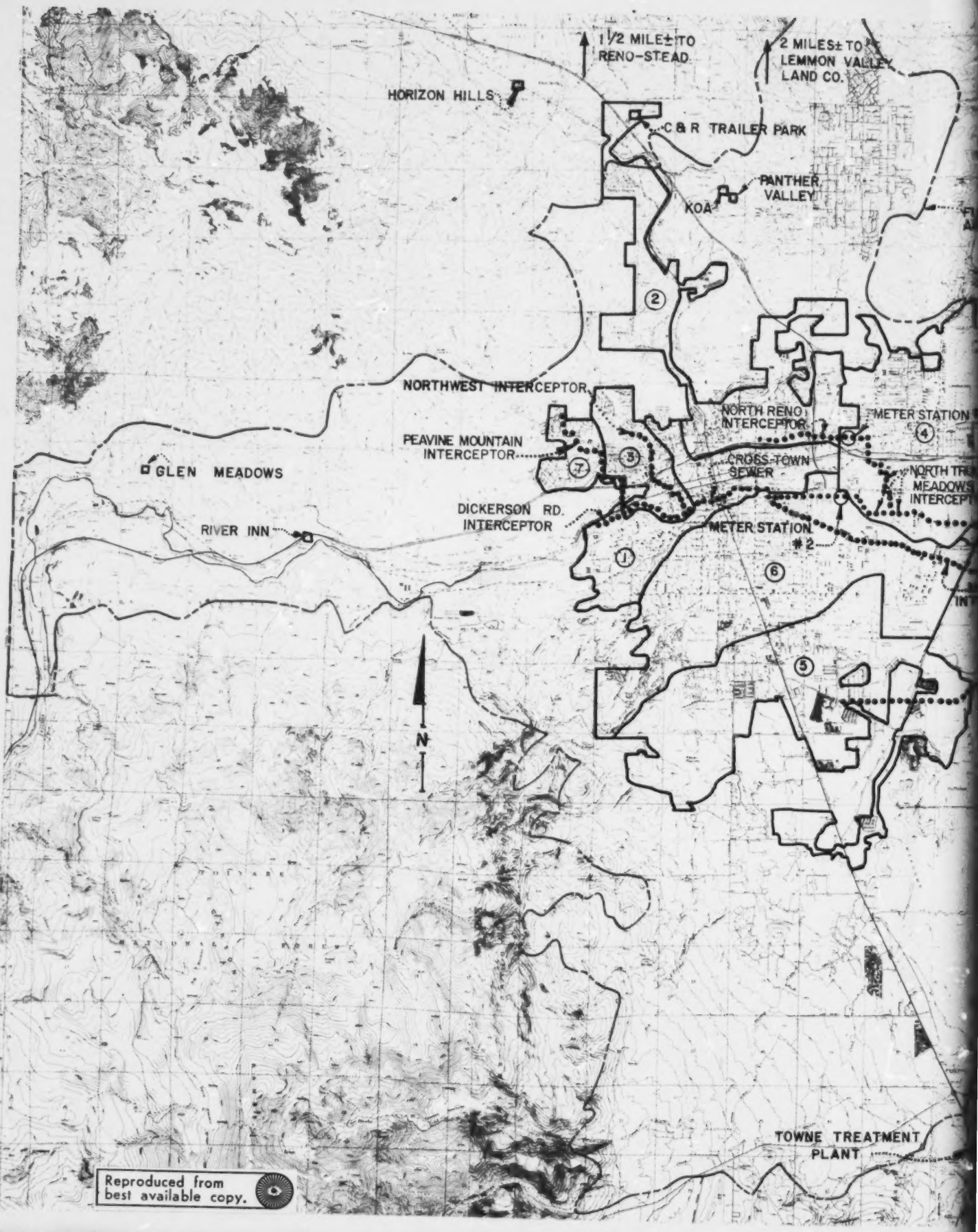
  The North Reno Interceptor serves north and northeast Reno including the University of Nevada, Raleigh Heights, and Panther Valley, or a total of 7,100 acres shown as Area 2 on Figure 3-17.

  This interceptor was constructed between 1965 and 1968 to divert flows generated in Raleigh Heights, Panther Valley and northeast Reno above the depressed portion of I-80 prior to its construction. The depressed section of I-80 prevents gravity flow sewers from crossing the highway right-of-way. Pipe size varies from 27 to 30 inches. This interceptor will accommodate the Regional Planning Commission's 1995 population estimates for this area.

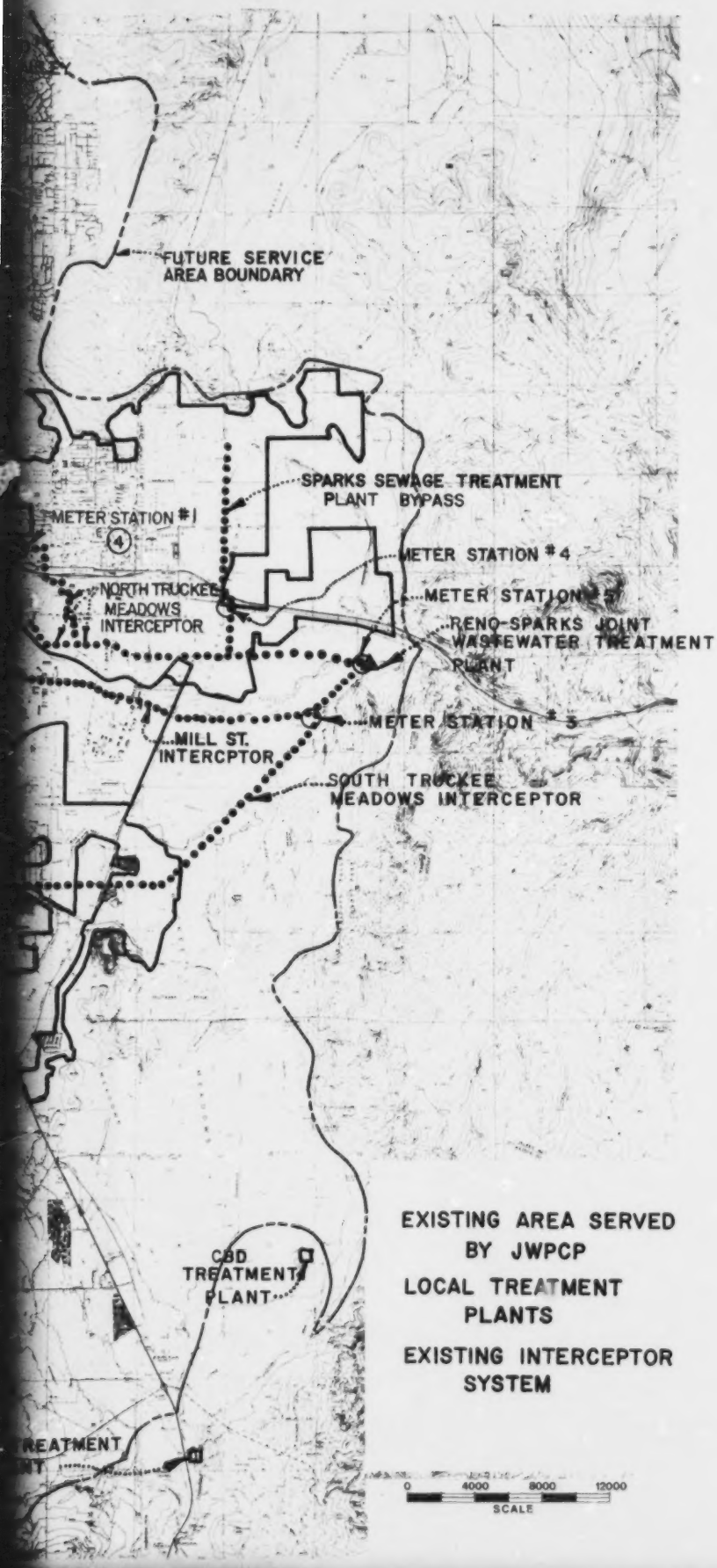
- North Truckee Meadows Interceptor

  This interceptor was constructed in three phases and was a joint venture between the Cities of Reno and Sparks. Project 3 connects with the North Reno Interceptor, north of Interstate Highway 80. Project 2 extends from the Old City of Reno treatment plant and picks up the Cross-Town Sewer flows. Projects 2 and 3 intersect at South Rock Boulevard, north of the Truckee River, the start of Project 1, which carries the sewage from Reno and Sparks to the joint treatment plant at Vista.

  The existing tributary service area consists of Areas 1, 2, 3, 4 and 7 totalling 16,800 acres.



Reproduced from best available copy.



LEGEND

AREA ①...CROSS-TOWN SEWER..... 2100 AC.
AREA ②...NORTH RENO INTERCEPTOR..... 7100 AC.
AREA ③...NORTHWEST INTERCEPTOR..... 900 AC.
AREA ④..NORTH TRUCKEE MEADOWS/ SPARKS BYPASS..... 6200 AC.
AREA ⑤...SOUTH TRUCKEE MEADOWS INTERCEPTOR..... 5200 AC.
AREA ⑥..MILL ST. INTERCEPTOR.....5500 AC.
AREA ⑦..PEAVINE MTN. INTERCEPTOR ....500 AC

○ METER STATION
MAJOR INTERCEPTOR
EXISTING AREAS SERVICED
□ EXISTING LOCAL WASTEWATER TREATMENT SYSTEM

FIGURE 3-17

TABLE 3-O

1974 CROSS-TOWN SEWER FLOWS

Sewer Section	Pipe Size (inches)	Design Capacity (Ave.) MGD	Average 1974 Peak Flows MGD	Reserve Capacity MGD	Ultimate Flow MGD	Ultimate Flow With Flow Above Arlington Diverted MGD
Booth St. to Vine St.	21	5.8	0.81	5.0	32.6	--
Vine St. to Arlington	30	15.0	3.9	11.1	36.4	--
Arlington to Center St.	24	8.6	4.3	4.3	37.7	1.3
Center St. to Evans Ave.	24	9.4	6.7	2.7	38.4	2.0
Evans Ave. to River	24 & 15	13.6	8.8	4.8	40.2	3.8
River to Locust St.	33	14.2	7.5	6.7	42.5	6.1
Locust St. to Giroux St.	33	19.0	9.5	9.5	44.5	8.1
Giroux St. to Kietzke Ln.	30	28.7	7.9	20.9	44.5	8.1
Kietzke Ln. to Old Reno Plant	39	23.0	11.1	12.0	45.72	9.3

Source: Cross-Town Sewer Report T.M.E. Nov. 1974

Project 3 pipe size is 33 inches and is designated to accommodate Regional Planning Commission estimates for the 1995 service area. Project 2 pipe with 11.8 MGD capacity downstream of the old treatment plant site is currently carrying 97 percent of its capacity and is handling peak flows as high as 20 MGD with surcharge conditions at upstream manholes. It has capacity to handle 1995 Regional Planning Commission population estimates when the Mill Street Interceptor extension (proposed Cross-Town Sewer) is completed. Project 1, with pipe sizes ranging from 42 to 60 inches in diameter, will accommodate 1995 sewage flows from tributary areas shown on Figure 3-17.

- Northwest Interceptor

  This interceptor is connected to the existing Cross-Town Sewer at Riverside Drive and Vine Street and extends north as shown on Figure 3-17.

  The Northwest Interceptor currently serves 900 acres near the northwestern edge of the Reno corporate limits north of the Truckee River designated as Area 3.

  This 21 and 24 inch interceptor was constructed in 1962 by the City of Reno with capacity of 6.84 MGD. In keeping with the Sanitary Sewer Master Plan, the Northwest Interceptor has capacity to service the 1995 Regional Planning Commission population estimates.

- Dickerson Road Interceptor

  The Dickerson Road Interceptor has been constructed in phases, and has been referred to as the Lawton-Verdi Interceptor Phase 1. This interceptor begins with a connection to the Cross-Town Sewer at Riverside Drive and Booth Street and continues northwesterly to Dickerson Road. It represents an extension of the Cross-Town Interceptor to the west. A portion of Area 7, shown on Figure 3-17, is presently served by this interceptor. West of Jones Street, this pipe is 42 inches in diameter.

- Mill Street Interceptor

  The Mill Street Interceptor connects to the South Truckee Meadows Interceptor at Kimlick Lane and extends westerly in Mill Street to Kirman Avenue.

The present area served consists of 5,500 acres in the south central and southwest Reno area, shown as Area 6 on Figure 3-17.

- Spanish Springs Interceptor

The Spanish Springs Interceptor was completed in 1975 and extends from the North Truckee Meadows Interceptor to Prator Way. It has been designed to serve ultimate population in areas known as North Truckee Meadows and Spanish Springs Valley with an ultimate service area of 60,000 acres, portions of which are contained in Service Area 4. Spanish Springs Valley is yet to be served, and is not included in the year 1995 service area.

Interceptor construction began in 1969 and was extended in phases to its existing location at Kirman Avenue. From its inception it was planned to accommodate all flows from regions west of Arlington Avenue to the City of Verdi. Line capacity at Gould Street is 33.7 MGD. Interceptor size ranges from 39 to 60 inches in diameter. This line has capacity to support 1995 Reno populations living west of Arlington Avenue and the service area west of Reno, including the Lawton and Verdi areas.

- South Truckee Meadows Interceptor

This interceptor extends southwesterly from the existing Reno-Sparks JWPCP and intercepts flows from the Mill Street Interceptor at Kimlick Lane. It continues southwest to Boynton Lane where it turns west beneath the southern end of the north-south runway at Reno Municipal Airport, and continues west in Model Way to Neil Road.

The area presently served by the South Truckee Meadows Interceptor consists of 5,200 developable acres located in the southeasterly portion of Reno.

This existing reach of interceptor was completed in 1968. The South Truckee Meadows Interceptor has capacity to carry all flow generated in the 1995 sewer service area (Area 5) as shown on Figure 3-17. Pipe size varies from 48 to 72 inches.

- Peavine Mountain Interceptor

The Peavine Mountain Interceptor was constructed beginning in 1974 and extends from the Dickerson Road Interceptor north to the vicinity of Wyoming Avenue. This interceptor relieved the capacity of the Northwest Interceptor so that it is capable of accommodating the 1995 flows. The Peavine Mountain Interceptor presently serves the westerly most areas within the City of Reno north of the Truckee River (as shown in Area 7 of Figure 3-17) and is capable of providing for the 1995 flows from its ultimate tributary areas.

- Metering Stations

Five metering stations are currently being utilized to determine sewage contributions from Reno and Sparks. For discussion purposes, each has been assigned a number as shown on Figure 3-17.

Meter Station 1 is located near the eastern end of East Ninth Street at Shoshone Avenue. Monitoring data from 1975 indicates an average annual flow of 2.05 MGD being carried by the North Reno Interceptor Sewer from areas west of the meter location.

Meter Station 2 is located on the west side of the Truckee River, southeast of the Reno Animal Shelter. Monitoring data from 1975 indicates an average annual flow of 6.53 MGD being collected by the Cross-Town Sewer in areas west of the meter location.

Meter Station 3 is located on the South Truckee Meadows Interceptor north of the connection with the Mill Street Interceptor. Metering data from 1975 indicates an average annual flow of 5.36 MGD is carried to the existing treatment plant via the Mill Street and South Truckee Meadows Interceptors.

The combined flow rates of Meters 1, 2, and 3 represent the average amount of sewage flowing to the existing joint treatment plant from the City of Reno.

Meter Station 4 is located at the old Sparks Sewage Treatment Plant south of I-80 and east of McCarran Boulevard. Metering data from 1975 indicates average annual flows of 4.0 MGD.

Meter Station 5 located at the Reno-Sparks JWPCP monitors all flow into the plant. Readings from 1975 of approximately 18.3 MGD represent all sewage from the City of Reno (Meters 1, 2, and 3) plus the sewage through the Sparks meter (Meter 4) and plus the unmetered sewage amounts generated in Sparks. Meter Station 5 (MGD) minus the sum of Meters 1, 2 and 3 (MGD) equals the flow from Sparks, and was approximately 4.4 MGD in 1975.

Infiltration/Inflow Quantities (K-1)

As an alternative to constructing a larger facility, Kennedy Engineers, Inc. investigated improving the collection system to reduce wet weather flows. Data on wastewater flow quantities was analyzed to evaluate infiltration/inflow (I/I). To estimate the quantity of I/I, historical wastewater flows were characterized as to source by analyzing relationships between wastewater flows and population, wastewater characteristics, precipitation, domestic water consumption, groundwater level, and river level. Findings and conclusions of the I/I analysis for Reno-Sparks are summarized as follows:

- There is no evidence of significant infiltration into the existing wastewater collection systems.

- Stormwater inflow enters the collection system through combined sewers in portions of the service area. This inflow is estimated to average approximately 84 million gallons per year, representing only 1.3 percent of the present total annual wastewater flow to the Reno-Sparks JWPCP.

- Since January 1967, when the Reno-Sparks JWPCP began operation, stormwater inflow has decreased. This decrease is attributable in part to the on-going programs of Reno and Sparks for separating storm sewers from sanitary sewers.

- Inflow is expected to decrease as the sewer system separation programs of the Cities of Reno and Sparks continue.

- It is expected that infiltration will not increase significantly in the future because of improved pipe joint materials available for new sewer construction and because of expected depression of groundwater levels as irrigated agricultural areas decline due to encroachment of urban development.

- For the five highest single day flows of record to the Reno-Sparks JWPCP, the ratios of peak daily flow to average monthly flow range from 1.3:1 to 1.57:1. These peak flows would not be expected to cause significant upsets of the wastewater treatment processes.

- Instantaneous peak flows from the Reno-Sparks wastewater collection systems have not been metered because of the plant operational practice of manually controlling the influent slide gates in order to limit the peak flow to approximately 28 MGD. The practice minimizes the impact of peak flows on the treatment process and is possible because of the large storage capacity in the interceptor sewers. Since all recorded peak daily flows are less than 28 MGD, it is unlikely that measurements of daily flows were distorted significantly by the manual regulation of instantaneous peak flows.

- Due to the practice of manually regulating peak wet weather flows, magnitudes of the instantaneous peak rates of flow are not known; however, they have not had significant adverse effects on the treatment processes.

- The present practice of manually suppressing instantaneous peak flows by using storage capacity in the interceptor sewers can be continued. The existing interceptor sewers have significant capacity available for storage, since some of them are sized for ultimate development within the Ultimate Service Area.

- The impact of peak wet weather flows on the treatment processes will decrease as stormwater inflow decreases and dry weather flow increases with urban development.

- Costs of treating the estimated 84 million gallons per year of stormwater inflow are primarily for pumping and chlorination. No additional facilities or manpower would be required. The estimated incremental cost for treating the stormwater inflow is approximately $500 per year. The incremental present worth of treating stormwater inflow for a 20 year period based on a 7.0 percent interest rate, is approximately $5,300.

- It is much less costly to treat the relatively small present quantity of inflow than to conduct a sewer system evaluation survey and rehabilitation program. However, it is important that the Cities of Reno and Sparks continue their sewer separation programs so that the design capacity of sanitary sewers can be realized without surcharging and possible overflows caused by stormwater can be eliminated. Such overflows could cause health hazards as well as surface water pollution.

Reclamation and Reuse Potential (K-1)

Approximately 500,000 acre-feet of water flows in the Truckee River at Reno annually, as described previously in this report under the heading of Surface Water Hydrology. The water budget for the Truckee Meadows area is shown in Figure 3-5. The sewage treatment plant returns the majority of its influent flow (about 18,000 acre-feet per year) to the Truckee River; this flow is being used as irrigation water downstream and as water to maintain input to Pyramid Lake. When this amount is compared to the total river flow, it is evident that reasons for reuse as potable water are minimal.

The plant effluent waters could be used for irrigation in Truckee Meadows and thereby free an equal amount of river waters for higher uses. Pumping would be required to accomplish this since the treatment plant is at the lowest point in the valley. Such a scheme would not be cost-effective or energy-efficient, since presently the irrigation waters are delivered by gravity flows from upstream diversions.

Although plant effluents and sludges, if used as irrigation waters in Truckee Meadows, could provide nutrients for the soil, seasonal requirements of irrigation waters and nutrients would demand storage in the winter; and careful application rates in the irrigation season when the groundwater is highest, to prevent degradation of same. In addition, much of the agricultural land in the Truckee Meadows is now in the floodplain and plant effluent for irrigation could be washed into the recovery waters during periods of inundation.

Existing Local Self-Contained Sewerage Systems (W-1)

There are currently ten local wastewater treatment facilities operating within a 15 mile radius of the Reno-Sparks JWPCP

(Figure 3-17). These facilities are operated by: 1) General Improvement Districts; 2) Private Concerns; and 3) Public Concerns. Ownership, treatment capacity, present flow, treatment process, type of disposal, and dates constructed appear in Table 3-P. The combined treatment capacity of the ten local treatment systems is 1.1 MGD, which equates to approximately 8,100 persons (B-6).

A portion of the planned treatment plant expansion program is designated to accommodate existing unsewered developments, and developments using short term local plants. Four of the existing wastewater treatment plants (River Inn, Panther Valley, KOA Campgrounds and Glenn Meadows) are designated to be phased out within the 1985 to 1995 planning period and their flows diverted via existing and future interceptor systems to the JWPCP at Vista. The combined tributary flow from these plants will be 0.0324 MGD representing a population of 240 persons (B-6).

In addition to these 240 persons served by local plants, it has been estimated that 19,623 persons within the designated 1995 service area rely on septic tanks, cesspools, seepage pits, and other individual treatment systems. The distribution of persons not served by the regional treatment facility within the 1995 service area is shown in Table 3-Q.

TABLE 3-Q

DISTRIBUTION OF PERSONS NOT SERVED
BY REGIONAL TREATMENT FACILITY
(1975 Service Area)

Geographic Area	Population (1973 TAZ)
North of Reno	8,689
East of Sparks	48
South of Reno	4,909
West of Reno	3,132
Reno Metropolitan Area	3,085
TOTAL	19,863

Examination of the total population figure indicates that sewer service to these persons alone would increase average daily flows to the JWPCP by approximately 2.7 MGD.

TABLE 3-P

EXISTING LOCAL SEWERAGE SYSTEMS

Authority	Ownership			Treatment					
	Public	General Improvement District	Private	Capacity MGD	Present Flow MGD	Process	Effluent Chlorination	Disposal	Date Constructed
Reno/Stead	X			0.5	0.4	Oxidation ditch	No	Dry lake evaporation percolation (E & P)	1941
KOA Camp-grounds (a)			X	0.0165	No data	Stabiliza-tion ponds	No	E & P	1971
Panther Valley (a)		X		0.01286	At capacity	Stabiliza-tion ponds	No	E & P	1960's
C & R Trailer Court			X	0.0125	New capacity	Stabiliza-tion ponds	No	E & P	1960's
Horizon Hills		X		0.06	Minimal	Stabiliza-tion ponds	No	E & P	1960's
Valley Water Co.			X	0.3	0.07	Contact stabiliza-tion package plant	No	E & P	1972
Glenn Meadows Trailer Court			X	0.09	Minimal	Stabiliza-tion ponds	No	Spray irrigation	1974
River Inn			X	0.003	Exceed-ing capacity	Stabiliza-tion ponds aqua jet aeration & low spray aeration	No	E & P some hauled to R/S JWPCP	1966 & 1973
Dorothy Towne			X	0.011	At capacity	Aerobic di-gester (pack-age plant)	No	E & P	1960's
C B D			X	0.0825	0.06+	Air aqua aerated lagoons	No	E & P pond	1971

NOTES: (a) To be phased out in October 1977.

CHAPTER IV

URBANIZATION OF THE SERVICE AREA

INTRODUCTION

An essential ingredient in the rational planning of wastewater treatment facilities is the realistic projection of future wastewater flows. Such flow figures must be based on reliable estimates of future population and economic activity within the identified service area. It is the purpose of this chapter to catalog existing urban conditions in the Reno-Sparks area and to summarize projections for future growth as a basis for evaluating the proposed facilities for sewage flow conveyance.

The Water Quality Management Plan (W-1) prepared for the Washoe Council of Governments (WCOG) estimated the 1973 populations of the Cities of Reno (excluding Reno-Stead) and Sparks at approximately 85,000 and 38,000 respectively, for a total of 123,000 and predicted 1995 population of 253,705 with an additional tourist equivalent population of 42,475, totaling 296,180. However, Kennedy Engineers, Inc. in preparing their facilities plan for the pollution control plant expansion concluded that the population increase to 296,180 would probably not occur until the year 2000 (K-1).

A 2000 population of 296,180 represents approximately 40 MGD of wastewater to be treated by the expanded Reno-Sparks JWPCP. The majority of this wastewater will be produced by the resident population of the Reno-Sparks area. The remaining wastewater will be produced by tourists to the Reno area. The area within the city limits of Reno and Sparks (approximately 37 square miles), is developed or zoned largely for residential and commercial use (tourism-gaming), with approximately 20 percent of the area developed or zoned for industrial use (warehousing, light manufacturing, distribution center). The remaining portion of the service area, about 77 square miles, is zoned largely for agriculture or ranching.

However, if water conservation measures are effective or if projected per capita flows are too high then the plant will be able to accommodate a population of 296,000. Therefore, to consider the worst case in the EIS, secondary impacts are based on a population estimate of 296,000 people.

GROWTH PATTERNS

Overview

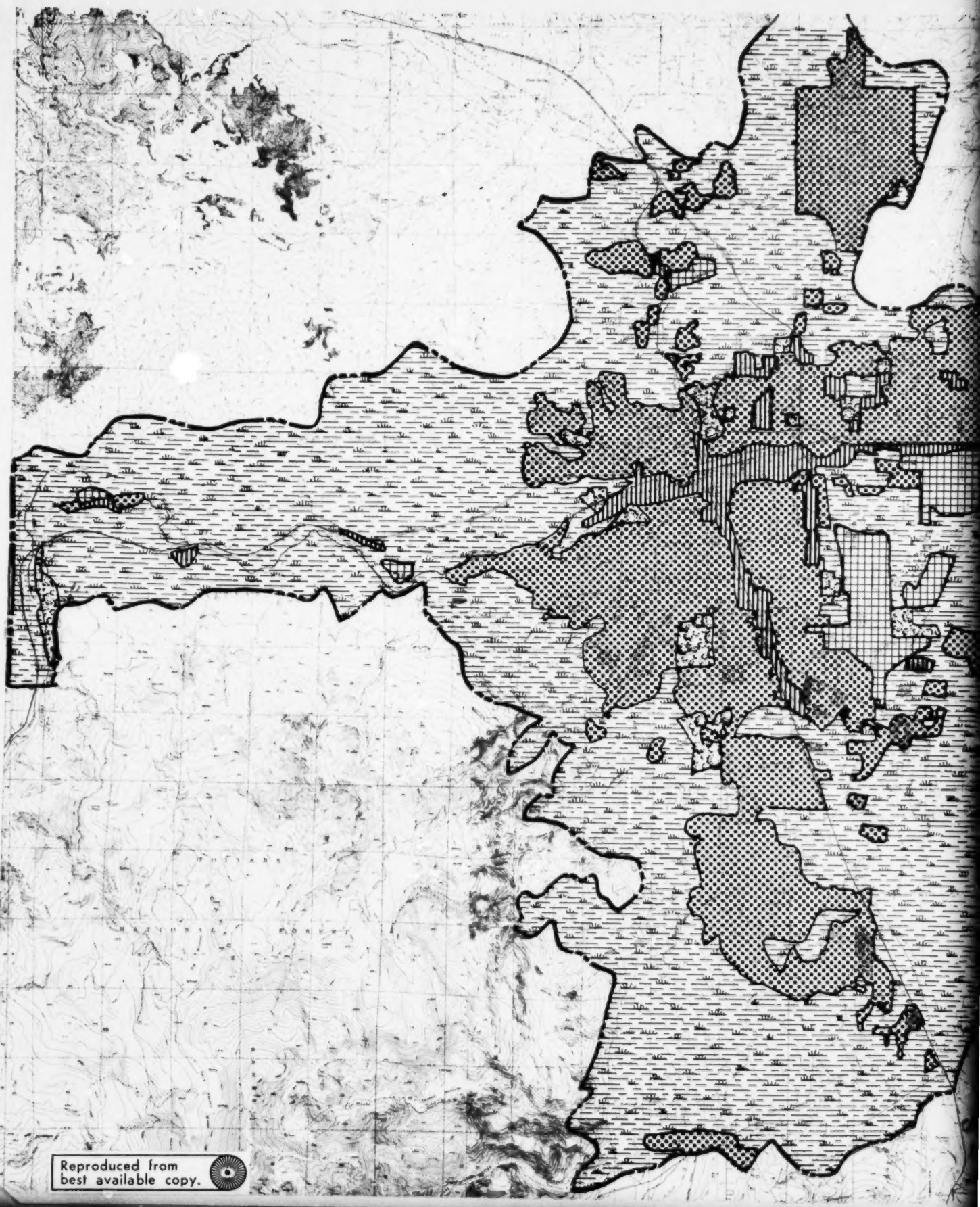
Major growth in Washoe County has occurred in the Truckee Meadows area. Rural areas have experienced a much smaller growth rate and in some cases even show decline. A review of growth patterns in the Truckee Meadows area shows that it has been developing contiguously from existing urbanization rather than in a sprawl pattern. Physical constraints such as the Carson Range to the west and the Virginia and Pah Rah Ranges to the east, have contributed to this relatively compact pattern of development east and west along I-80, the Truckee River and railroad, south along Highway 395 and, most recently, north in the Sun Valley and Lemmon Valley area. Thus, the picture of urban development in this area is one of Reno and Sparks effectively meshing, and a continuing growth of urban development through an expansion process as opposed to the creation of elongated urban development patterns emanating from a basic core area. Land uses with the study area are shown on Figure 4-1.

Urbanization has generally occurred in the lower portion of natural drainage basins and sewers have been designed for gravity flow. The sewer service boundary has expanded over the years to accommodate additional, developable areas. The present boundary, as most recently constituted in 1972, follows topographic limits. It is important to note that legally adopted land use plans will set land use development and population levels. However, the constraints inherent in the sewer service boundary will contribute significantly to the final pattern of urbanization and to the distribution of population within the service area.

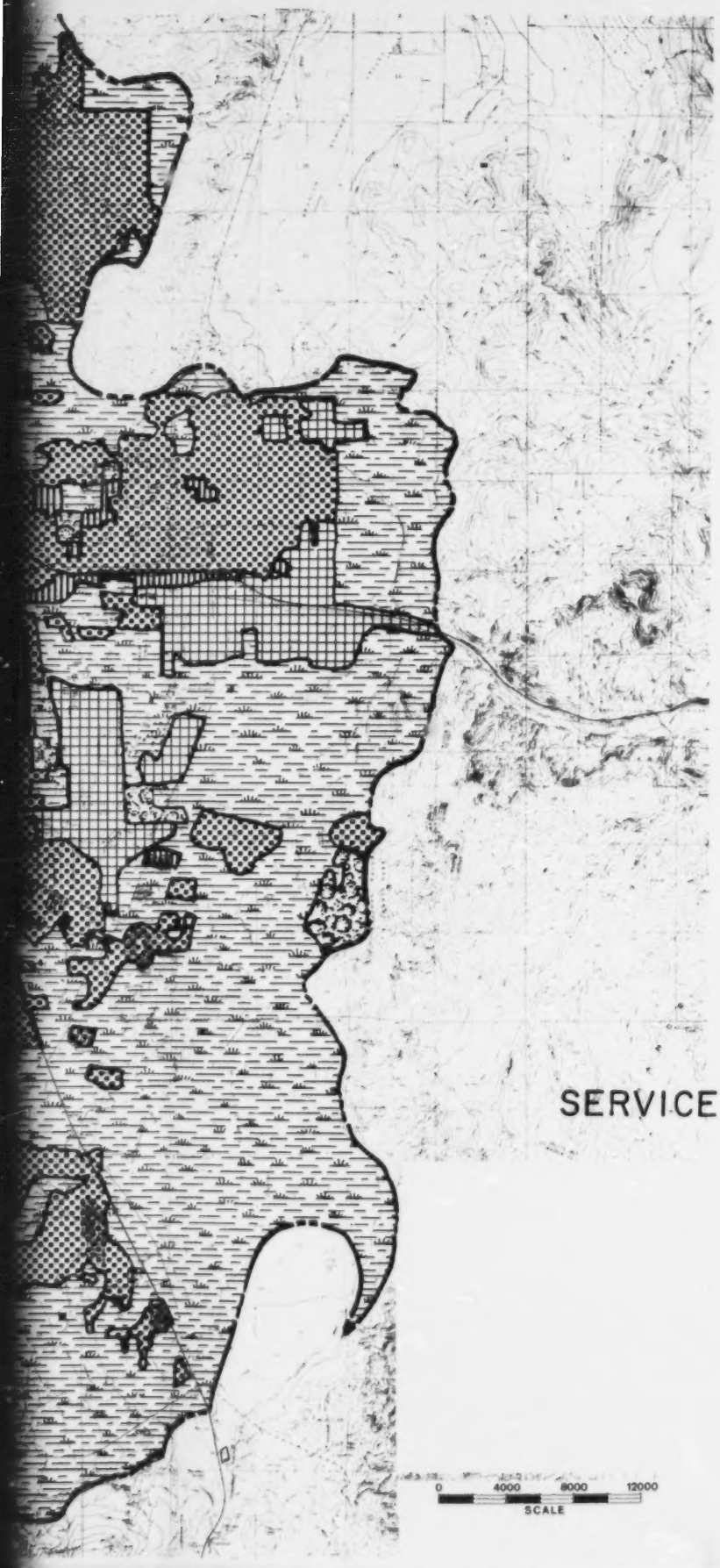
- Reno

  The City of Reno has in succession been a trading center, transportation hub, tourist and vacation mecca, warehousing distribution point, and a combination of all the above. The physical characteristics of the city have a decided relationship to major transportation facilities; namely, the two railroads, Southern Pacific and Western Pacific, and the two U.S. Highway routes, U.S. 40 (I-80) and U.S. 395.

  The city was originally established on the gently rolling bottomland of the Truckee Meadows. Generally speaking, urban development in Reno has tended to



Reproduced from
best available copy.



LEGEND:

- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- URBAN OPEN SPACE
- AGRICULTURAL/ UNDEVELOPED

SERVICE AREA LAND USE

FIGURE 4-1

radiate outward from the Virginia Street - Truckee River Crossing with emphasis on following the transportation routes. Residential expansion to the northwest and southwest has moved to and into the foothill areas. Recent annexations have included land upstream along the Truckee River toward Verdi. Annexation of Stead airbase in 1967 expanded the city limits beyond Truckee Meadows proper into the foothills north of Reno and beyond into the Lemmon Valley area.

Within the present boundaries of the City of Reno some 70 percent of the land is devoted to urban uses. Vacant land is used agriculturally, held open for future use, or is barren land. Approximately 2,535 acres, or 11 percent of the total incorporated area of 23,100 acres is in public ownership.

Within Lemmon Valley, an extensive area has been planned and controlled by governmental agencies other than the City of Reno, namely the area originally known as Stead Air Force Base. Transition in control of the Stead area has occurred since the 1950's first to the state and then to private ownership except for specific areas reserved by the City of Reno and Washoe County. During the period between 1963 and 1973 developed acreage has increased from 821 acres to 1,656 acres. This increase is substantially due to the replacement of military use with industrial and governmental uses.

Within unincorporated areas which could likely become part of the City of Reno, land is irrigated desert for agricultural use or is utilized for large-lot residential purposes. This latter use is especially true of areas southwest of the city. Some strip commercial development has occurred along major highways, especially U. S. 395 (Virginia Street) to the south.

- Sparks

The City of Sparks originated with its establishment by the Southern Pacific Railroad, as the new site for repair shops and a division point. With de-emphasis of the railroad, the community has gained importance as a tourist center and as a warehousing and distribution point.

The physical limits of the city were originally oriented to the railroad shop areas and U.S. Highway 40. The old railroad right-of-way (Prater Way) forms a prominent diagonal within an otherwise rectangular urban pattern.

The city was originally established on gently rolling bottomland of the Truckee Meadows. Urban development in Sparks has tended to radiate outward from the rectangle which formed the original city limits. Expansion has begun to move into the foothills north of the city. Recent annexations have added land to the north and east and industrial development south of the railroad. Thus, expansion has generally tended toward the north, east, and south. The existence of the City of Reno to the west has influenced this pattern. Public lands within the city constitute approximately 425 acres of the total incorporated area of approximately 5,000 acres.

- Washoe County

The remainder of the sewer service area outside the urban areas is primarily zoned for agriculture and ranching. This constitutes an area of approximately 94 square miles. The continuous increase in urbanization within the Truckee Meadows Basin has reduced the land available for agriculture and ranching. In the Truckee Meadows Basin, excluding the incorporated areas, public land ownership comprises approximately 4,040 acres of approximately 35,243 acres. The public ownership acreage within the entire service area is approximately 7,000 acres of the total 85,000 acres. In Washoe County as a whole land ownership is distributed as follows: 69.3 percent publicly owned (used primarily as recreation for visitors); 19 percent private; 11.7 percent Indian Reservation (W-1).

LAND USE PLANNING

On-Going Process

Planning organizations serving the Reno-Sparks-Truckee Meadows area are: Reno, Sparks, and Washoe County Regional Planning Commission and the WCOG. Zoning for the area is vested in the Reno, Sparks, and Washoe County Regional Planning Commission. The Regional Planning Commission is, at

this time, in the process of updating the General Plans for Reno and Sparks as well as the surrounding county area. This is an important action since detailed consideration of the inter-relationship of various planning components such as land use, circulation, housing, seismic safety, public safety, open space and recreation, conservation, scenic highways and noise, included as part of the General Plan update.

The Commission is gathering and analyzing a wide variety of data, much of which is being prepared in cooperation with the State Highway Department, for computer storage, retrieval and analysis. These data include:

- interpretive maps of ownership and parcelization
- land use tabulation by 11 categories
- designated traffic analysis zones (TAZ)
- computer files for data retrieval by TAZ as to land use, topography, number of housing units, soil type and geology

This information will be used to develop a composite urban land use suitability map, a composite conservation suitability map and a composite commercial resource extraction map. Detailed forecasts are also being prepared of land use and population; these together with the composite suitability maps will be combined into a regional land use conflicts-compatability map. This effort is scheduled for completion late in 1976, and, upon acceptance by the Commission, will replace the current General Plan.

In addition to the aforementioned General Plan review, a citizen Blue Ribbon Task Force Program, organized to review the planning process within the urban areas of Reno-Sparks and surrounding Washoe County, has conducted an intensive study of various subjects including water (B-1), air pollution (B-2), housing (B-3), codes (B-4), design (B-5), physical constraints (B-6), economics of growth (B-7), public finance (B-8), optimum size (B-9), and plan relationships (B-10).

Final reports were produced in each subject area. These reports were intended to provide expert and citizen input as well as necessary background information for the re-evaluation of local governmental programs and functions. The Task Force Reports were further intended as an added basis for upcoming 5 year reviews of an existing comprehensive plan for Reno, Sparks, and Washoe County.

The Reno-Sparks area has had, and is continuing to have, one of the higher population growth rates in the country. Future growth will depend on many issues including the resolution of conflicting demands on limited water supply (A-1). General Plan revisions will not be available for several months. As reported in this chapter, then, the currently adopted General Development Plans for the Cities of Reno and Sparks have been used to forecast the type, amount and location of future land use.

Forecasted Land Use

Many variables affect future land use. These include 1) local and regional growth policies; 2) environmental constraints, including air and water quality standards; 3) economic conditions; 4) the supply of energy; 5) demographic and social trends, such as the rate of natural population increase and migration patterns; 6) indirect governmental influence through tax structure, transportation and housing programs; and 7) provision of adequate public services and facilities.

How these variables interact over the short and long term will determine urban growth and development patterns. Private investment decisions and public facility planning are heavily dependent on forecasts of land use. A variety of techniques are available for land use forecasting including judgemental approaches, extension of past trends and relationships, and computer-based models.

The currently adopted 1971 General Plan for the City of Reno basically encompasses an area composed of land abutting the City of Sparks on the east, north of the Truckee River; abutting the base of the Virginia Range on the east, south of the Truckee River; abutting the base of the Carson Range on the west; bounded on the south by an east-west line that is approximately 1/2 mile south of Huffaker Lane; and abutting the base of Peavine Mountain on the north and northwest.

The General Plan for the City of Sparks generally encompasses an area of land bounded by the City of Reno on the west; bounded by the Truckee River on the south; bounded by the base of the Pah Pah Range on the east and northeast, bounded by the Wedekind Hills on the northwest; and bounded on the north by an east-west line that is approximately 1.5 miles north of North McCarran Boulevard.

The stated planning goals and objectives for the Cities of Reno and Sparks, expressed in both General Plans (R-6, R-7) are:

- forming the community into efficient service units
- achieving a high standard of residential development
- providing properly located land for business to serve each neighborhood in quantities based on realistic estimates of present and future needs
- providing accordance with projected needs,
- encouraging the tourists-oriented economy of the city
- providing adequate and well located public facilities, including schools, parks, fire houses, police stations and other public buildings,
- providing a complete and efficient street system including limited access highways, major arterials, collectors, and local streets

Table 4-A, below, summarizes the land use assignments which are made in the General Plans for the two incorporated cities.

TABLE 4-A

GROSS LAND DISTRIBUTION
AS SHOWN IN ADOPTED GENERAL PLANS

USE	Percent of Total RENO	SPARKS
Residential	51.3%	45.0%
Commercial	7.3%	6.0%
Industrial	7.5%	23.0%
Community Facility	15.5%	16.0%
Vacant or Other	18.0%	10.0%

Source: (R-6, R-7)

The most intensive urban and industrial uses for both cities have been developed and are expected to continue to develop on the irrigated croplands in Truckee Meadows. The Truckee River Basin alone in the Central Lahontan area is projected to convert over 31,000 acres from irrigated cropland to urbanization between 1973 and 2020 (A-1).

The major potential developable annexation areas outside the present water service include, for Reno, the Truckee Meadows area south to approximately State Route 27, and the Lawton-Verdi corridor westerly along I-80 to Stateline, (R-7), and for Sparks, the Sun Valley area to the north and Spanish Springs Valley to the northeast (R-6).

Of the four areas noted above, two require special attention since they are included within the year 2000 service area; namely, the Lawton-Verdi corridor proposed for development in connection with the City of Reno, and the Sun Valley area proposed for development in connection with the City of Sparks. As noted earlier, the Washoe County Revised General Plan is several months from completion. At the present time neither the Lawton-Verdi corridor nor the Sun Valley area are shown on the adopted 1971 General Development Plans for Reno or Sparks. Thus to forecast specific land uses for either of these areas before the Regional Planning Commission's studies are complete would be premature. At best a generalized conjecture may be made of development in the area. However such generalizations are subject to change once the completed planning studies are available.

- Lawton-Verdi Area

  For the most part, the area between Lawton and Verdi is zoned for agriculture. Near the community of Lawton there is a small amount of commercial with a larger area of industrial zoning. At Verdi, there is a small amount of strip commercial zoning with some industrial zoning north of the community. In general, the developable area within the corridor is a river aluvial plateau varying in width from 0.5 to 2.5 miles. The Southern Pacific Railroad Main Line follows the Truckee River. Interstate 80 passes through the valley in an east-west direction but is generally at a higher elevation than the river and does not closely follow the river route. In areas where the canyon becomes narrow, the distance

between the river, railroad and highway tends to limit usable land. These physical variations dictate the types of land uses which could be expected to occur in the corridor.

The only planning document covering the Lawton-Verdi area is approximately 10 years old and is not considered to be currently valid. A great number of physical constraints are attached to planning for this location and are now being studied by the Regional Planning Commission. For instance, the Commission is presently inclined to consider favorably development on slopes ranging from 0 to 15 percent slopes over 15 percent are considered less desirable for development. Considering the existing topography of the Lawton-Verdi corridor, the amount of land available for urban development would be significantly reduced by a 15 percent slope limit.

Just east of Lawton, Harrah's Auto World is proposing a major hotel-casino-museum complex. Such a use would appear to be the major urbanizing factor in the area. However, as noted, this facility would be located east of Lawton. West of Lawton, through the basic canyon area, there are some recreation vehicle parks, mobile home parks, and other scattered residential development, but no significant urbanization at this time. One important factor which has limited development over the past 5 years is the County Health Department prohibition of septic tank installations within 2,000 feet of the Truckee River.

- Sun Valley

The Sun Valley area north of the city limits of Sparks is characterized by rapid growth and a housing stock composed of mobile homes on relatively large lots. The 1970 census shows 2,000 residents in the area while a special census conducted in November 1975 indicates a population increase of 450 percent to approximately 11,000 persons. At present, the Sun Valley Water and Sanitation District has been created and plans are underway for a sewage collection system to replace the individual septic tanks which now serve this area. An outfall trunk sewer from Sun Valley to a point of connection with the Spanish Springs Interceptor in Sparks is a major element of the Sun Valley sewage plan. Effluent would be treated at the JWPCP thus adding to future flows.

The present zoning within the Sun Valley Water District Service Area is E-1, which permits one dwelling unit for each 15,000 square feet of lot area. Most dwelling units on these subdivided lots are prefabricated mobile homes. Assuming no zone change, the present density would permit a maximum population of about 16,000 persons in the water service area according to Regional Planning Commission staff. Outside the service area zoning is A-1, which permits one dwelling unit per acre. It is probable that this area will not be intensively developed in the near future.

Another function of the Sun Valley Water and Sanitation District is the distribution of domestic water purchased from the Sierra Pacific Power Company. Pursuant to this responsibility, the Power Company has asked the District to set the limits of its service area and to predict a holding population consistent with current zoning so that an adequate water supply can be allocated.

The Sun Valley area is considered to be one of the more likely locations within the study area to experience urbanization. The County Commissioners are now asking the Planning Commission and the Health Department to prepare a report of problems that exist with respect to septic tank installations.

Land Use Constraints

Superimposed on all future land use planning in the Reno-Sparks-Truckee Meadows regions are the issues and constraints identified in a report generated by the Physical Constraints Committee as part of the Washoe County Blue Ribbon Task Force study on growth. This Committee was composed of professional workers in their respective fields and lay people who had an interest in the subject matter areas. Although some physical areas were addressed in general fashion, enough data and comment was generated to focus intensive public interest on the Task Force conclusions. Consequently, the Commission's new General Plan will undoubtedly be influenced by the Task Force Study effort, particularly with respect to the following recommendations from the Task Force report (B-6).

Archaeology - locate and evaluate archaeological resources for future planning purposes.

Create ordinances requiring private developers to consider and mitigate adverse impacts

Fish and Wildlife - to insure the preservation of unique habitat for wildlife in the Truckee Meadows it will be necessary to maintain such unique areas as agricultural land.

Establish a greenbelt along the Truckee River, especially between Reno and Verdi.

Geology - identify, locate, delineate, and evaluate geological hazards in Washoe County, including earthquake hazards, landslides, flooding, and flash flooding, expansive materials and detrimental foundation conditions and energy and mineral resources.

Hydrology and Floods - floodplains should be shown on all planning maps (see detailed discussion below).

Restrictions on development should be made depending on the degree of probability of future flooding.

Seismic Problems - the Reno area is characterized by a great number of faults and many of these must be considered potentially active.

Establish the criteria for detail seismic zoning in the Reno-Sparks area.

Slope and Available Land - study the land area available for urban development and the maximum desirable population density that should be allowed.

Open space should be established in the vacant areas remaining in the lowlands and lower slope areas.

Steeply sloping land should be preserved

Soils - planning must consider both soils limitations and potentialities

Local soils-related problems and planning criteria and design requirements must be cooperatively studied.

- Flooding

The Reno-Sparks-Truckee Meadows area has a long history of floods. Early accounts indicate that flooding or periods of high water occurred in 1861, 1862, 1867, 1886, and 1890 (E-8). Since about 1900, when records of stream flow were begun, serious stormwater runoff occurred in 1907, 1909, 1928, 1937, 1950, 1955 and 1963. Snowmelt floods occurred in 1906, 1907, 1938 and 1952 (E-8). Cloudburst flooding occurs in the area, but is of shorter duration and less areal extent than rain or snowmelt floods. The most severe cloudburst flood known to have occurred was that from the Peavine Creek watershed in 1956 (E-8).

Commercial, residential, and industrial areas of Reno and Sparks are located in the floodplain and are subject to overflow from the Truckee River and its tributaries.

The occurrence of an Intermediate Regional Flood* on the Truckee River would result in considerable damage to commercial and entertainment facilities in downtown Reno, sizeable damage to public utilities, and moderate damage to streets and roads. Surface and air transportation and communications would be interrupted. On the tributary streams, irrigation facilities would be damaged, basements of homes and commercial establishments along the streams would be flooded, and vehicular traffic would be interrupted.

---

*Intermediate Regional Flood is defined as the flood that may be expected from the combination of meteorological and hydrologic conditions having a frequency of occurrence of once in 100 years (E-8).

The occurrence of a Standard Project Flood* on the Truckee River would result in severe damage to roads and streets, probably destruction of two bridges, closure of the municipal airport and disruption of rail transportation, deposition of a large amount of debris, and inundation of practically all homes and commercial establishments in the floodplain. On the tributary streams, a Standard Project Flood would result in severe damage to agricultural developments, severe erosion damage, deposition of large amounts of silt and debris, destruction of communication facilities and other public utilities, and inundation of the lower levels of homes and business establishments in floodplains (E-8).

The tributary streams, except Steamboat Creek, have little influence on the total area flooded in the Truckee Meadows during major rainfalls since the Truckee River flows predominate; however, the streams can inundate floodplain areas during cloudbursts.

The treatment plant site is above the elevation of the high water from both the Intermediate Regional Flood and the Standard Project Flood.

DEMOGRAPHICS

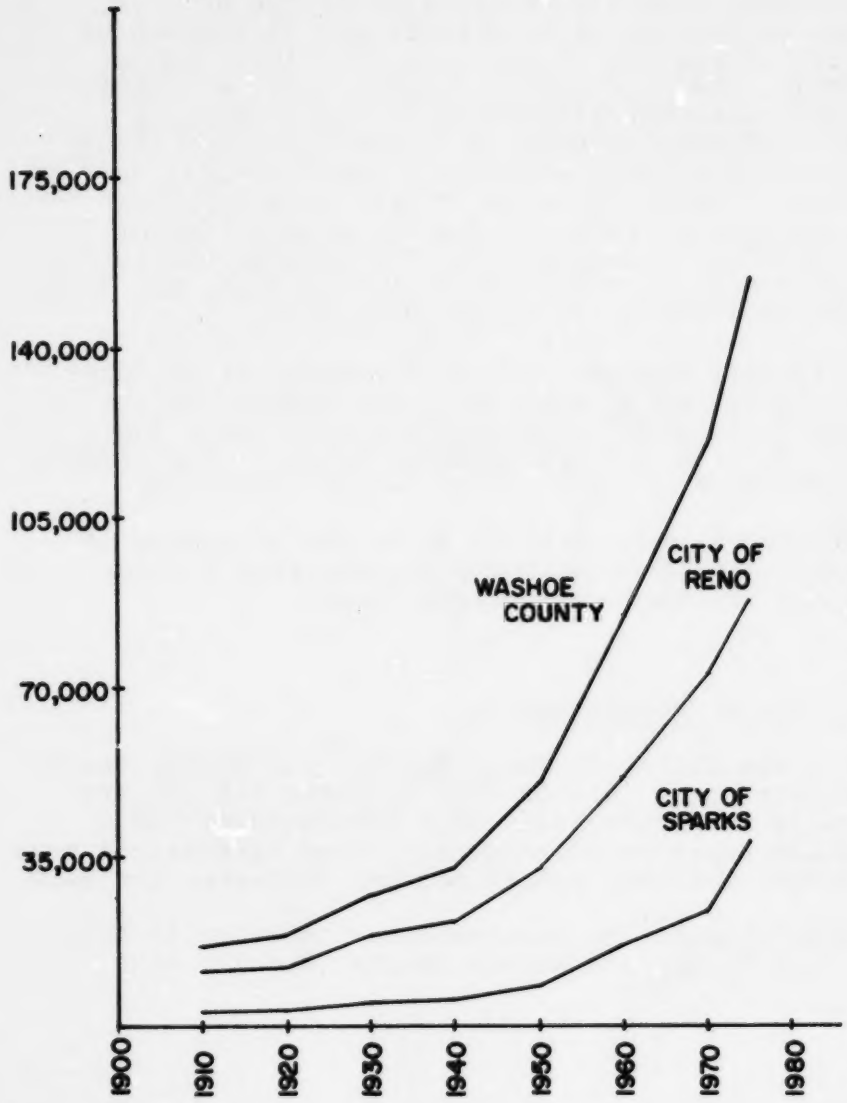
Existing and Historic Population

Populations for the Cities of Reno, Sparks, and Washoe County have been tabulated from 1910 to 1975 in Table 4-B and are shown graphically in Figure 4-2. Also tabulated in Table 4-B are urban and rural Standard Metropolitan Statistical Area (SMSA) populations and mean yearly percent increases for each.

Nevada's foremost population centers have historically been Clark County (Las Vegas) and Washoe County (Reno). Reno,

---

*Standard Project Flood is defined as the flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the drainage basin (E-8).



HISTORIC POPULATION

Figure 4-2

TABLE 4-B

HISTORIC POPULATION 1910-1975

Year	Washoe County		Reno		Sparks		Urban SMSA		Rural SMSA[a]	
	Population	Percent Increase	Population	Percent Increase	Population	Percent Increase	Population	Percent Increase	Population	Percent Increase
1914	17,434		10,867		2,500		13,367		4,067	
		7		11		30		14		-17
1920	18,627		12,016		3,238		15,254		3,373	
		46		54		39		51		22
1930	27,158		18,529		4,508		23,037		4,121	
		20		15		18		16		42
1940	32,476		21,317		5,318		26,635		5,841	
		55		52		54		53		63
1950	50,205		32,497		8,208		40,705		9,500	
		69		58		102		67		75
1960	84,743		51,470		16,618		68,088		16,655	
		43		42		46		43		44
1970	121,068		72,863		24,187		97,050		24,018	
		27		21		46		27		28
1975	154,154		88,111		35,215		123,326		30,823	
Mean Percent Increase/Year		4.2		3.9		5.44		4.26		4.07

NOTES: [a] Rural SMSA includes all unincorporated areas

Source: (E-24)

Sparks, and Washoe County comprised 29 percent of the total state population in 1970. The 1975 population of the Reno SMSA is estimated at 154,000, distributed as follows: Reno and Sparks, 88,111 and 35,215 respectively, totaling 123,326 or 80 percent of the total Washoe County population (C-15). The incorporated area of Reno-Sparks is 30,213 acres, yielding an average density of 4.08 people per acre. The acreage under study in this impact statement as defined by the Kennedy Engineers 201 Facilities Plan is 82,314 acres. Rural acreage is 51,921 with an estimated rural population of 5,135 persons or 0.10 persons per acre. Historically, Nevada's rural-to-urban population shift has been higher than the nation as a whole. In 1920, 50 percent of the American people lived in urban places, in 1970 this was 75 percent. By contrast in 1920 the Nevada population was 20 percent urban, with 80 percent urban by 1970. Birth rates in Nevada have been 11 percent higher than the national rate and death rates 14 percent lower. The population density of Nevada was 0.052 persons per acre, statewide.

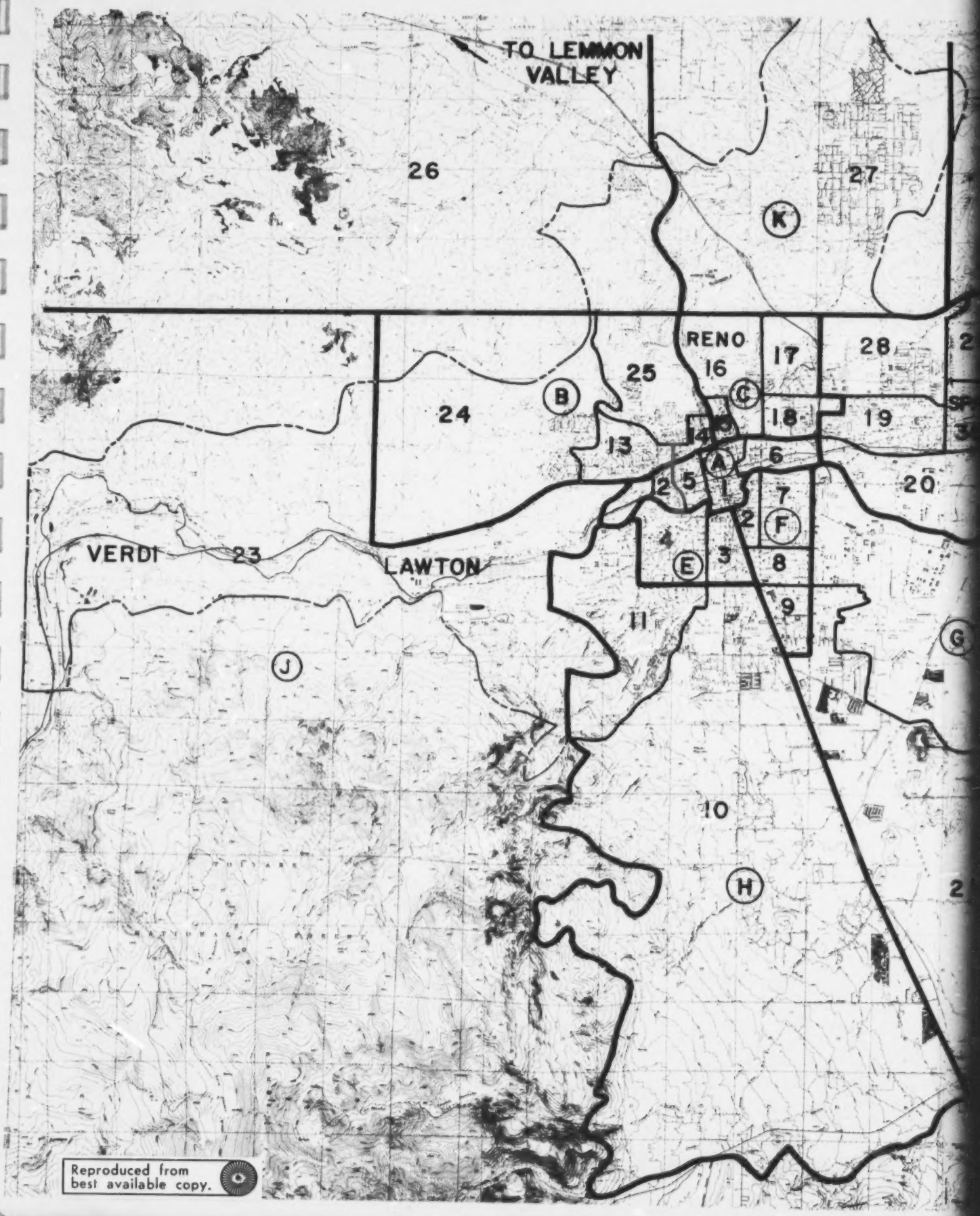
Racial Mixture

The Washoe County racial mixture as presented by the WCOG (B-3) is 93.4 percent persons of European decent, 5.0 percent persons of Spanish decent, and 1.6 percent persons of Negro ancestry. The Native American population consisting mostly of the Paiute Indians, is primarily concentrated in the Reno-Sparks Indian Colony and Pyramid Lake Reservation. Census data is not available on the Native American population. Persons of age 60 and older comprise 9 percent of the total county population with major concentrations in the Reno Metropolitan Area.

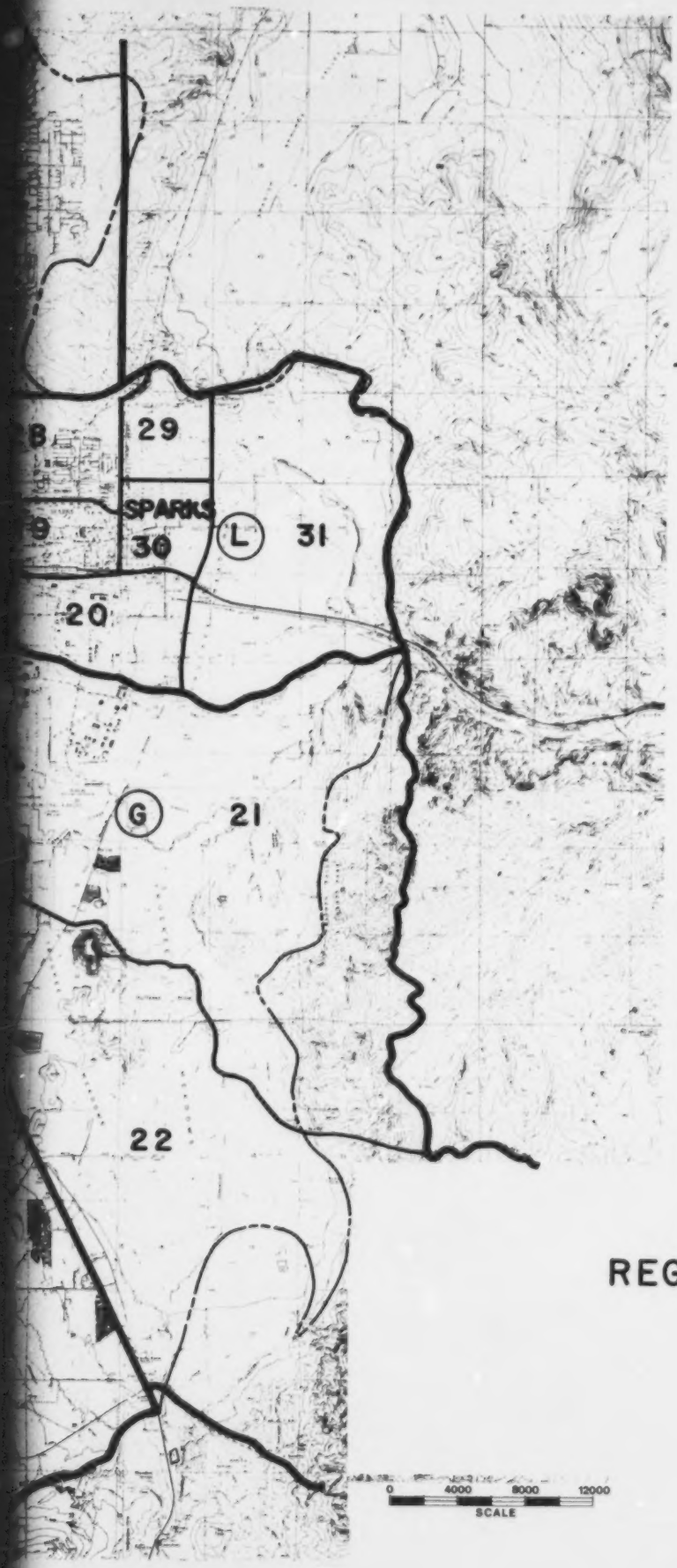
Census tracts for the SMSA are shown in Figure 4-3 as they pertain to the area designated for study in this report. Each tract has an associated percent racial population and number of persons age 60 and over as shown in Table 4-C.

Constraints on Future Population

Population increase will actually be a function of many elements, including economics and employment growth as well as social changes centering on family structure and planning. As pointed out previously, urban facilities such as transportation, fuel supply, housing, water, and sewerage capacity are also factors influencing land use and population distribution.



Reproduced from best available copy.



RENO-SPARKS
TREATMENT PLANT
SERVICE AREA BOUNDARY

A	CENTRAL RENO
B	N.W. RENO
C	N.E. RENO
D	LEMMON VALLEY
E	W. RENO
F	E. RENO
G	S.E. RENO
H	S.W. RENO
J	LAWTON-VERDI
K	SUN VALLEY
L	SPARKS

REGIONAL GROUPINGS OF CENSUS TRACTS

FIGURE 4-3

CENSUS TRACT NO.	REGIONAL GROUPING	EXISTING LOW-COST HOMES	TOTAL NO. RESIDENTIAL STRUCTURES (EXISTING)	% HOUSES IN POOR CONDITION	OLD STRUCT. DEMOLISHED (% of total)	SINGLE FAMILY DWELLING CONSTRUCT.	DUPLEX UNITS CONSTRUCT.	APARTMENT UNITS CONSTRUCT.	CONDOMINIUM or TOWNHOUSE UNITS CONSTRUCT.	TOTAL UNITS CONSTRUCT.	CONCENT-RATIONS OF SENIOR CITIZENS	RACIAL MIX — % of TOTAL POPULATION			CONCENT-RATIONS OF FAMILIES BELOW MEDIAN INCOME
												%white	%spanish	%black	
1	A	NONE	377	11	27	5	0	8	0	13	X X X X	2.7	2.2	5	X X X X
2	F	"	334	14	4.3	9	4	115	32	160		1.9	.8	1.7	X X X X
3	E	"	808	8	2.6	41	8	30	3	82	X X X X	3.4	1.5	.5	X X X X
4	E	"	1589	4	2.6	50	0	104	96	250	X X X X	4.3	6.8	.9	
5	A	"	386	7	16.4	2	2	174	0	178		1.8	2.1	1.7	X X X X
6	A	"	167	23	2.9	0	0	6	0	6		.5	1.2	9.0	X X X X
7	F	"	1096	2	4.0	14	2	116	0	132		4.0	1.9	2.6	X X X X
8	F	"	69	0	2.6	8	2	0	0	10		2.4	1.4	.4	X X X X
9	F	"	189	11	3.1	8	4	183	0	195		2.5	3.8	.2	
10	H	"	271	1	4.0	370	14	1422	187	1193		5.9	4.6	.3	
11	H	"	1140	0	3.7	286	0	295	180	761		6.7	5.3	.2	
12	A	"	234	1	7.1	10	6	172	37	225		1.8	1.6	.1	X X X X
13	B	"	572	0	0	40	0	0	13	53		2.7	3.5	.2	
14	B	"	847	0	.9	8	0	96	0	104		2.2	1.9	.9	X X X X
15	C	"	215	5	1.7	0	0	6	0	6		1.8	.7	1.5	X X X X
16	C	"	521	1	.4	2	0	0	0	2		2.4	2.3	8.8	X X X X
17	C	"	361	0	.2	24	30	180	104	338		1.5	1.3	16.5	X X X X
18	C	"	633	1	2.6	1	0	218	0	219		2.8	5.7	30.4	X X X X
19	L	"	993	10	2.6	6	102	430	0	538	X X X X	4.8	8.2	1.8	X X X X
20	L	"	113	11	.4	0	4	0	0	4		1.0	.5	4.2	X X X X
21	G	"	274	1	.4	378	0	0	0	378		1.6	2.1	.6	
22	G	<$30,000	1704	1	2.9	327	24	347	440	1138		4.2	2.5	.1	X X X X
23	J		228	8	0	311	20	11	22	364		.6	1.3	.1	X X X X
24	B	<$25,000	1668	0	7.4	416	4	82	0	502		5.0	3.3	.4	
25	B		286	0	.2	26	0	153	0	179		2.4	1.8	.4	
26	D	<$25,000	780	3		546	20	4	0	570		6.1	5.6	7.0	X X X X
27	K		209	9		72	24	3	0	99		2.3	3.5	1.7	X X X X
28	L	<$25,000	1504	2		30	20	462	0	512		4.7	5.2	1.0	
29	L	<$25,000	1684	0		658	0	80	0	738		5.7	7.6	.8	
30	L	<$20,000	1683	3		3	0	282	49	334		4.7	4.3	.8	
31	L		88	0		1272	2	206	24	1504		1.1	.3	.5	X X X X
			1975 ASSESSORS DATA		1970—1975										

A. Central Reno
B. N. W. Reno
C. N. E. Reno
D. Lemmon Valley
E. W. Reno
F. E. Reno
G. S. E. Reno
H. S. W. Reno
J. Lawton-Verdi
K. Sun Valley
L. Sparks

TABLE 4-C

DEMOGRAPHICS

Preceding page blank

Water supplied to the Cities of Reno and Sparks and consumed in homes and hotels, is reported to average 356 gpcd (R-11). The total water consumption, including irrigation, public supply, self-supplied industry, electric power, and rural use within the Truckee River Basin is considerably higher. In 1969, for example, it has been estimated that 71,000 acre-feet of water was consumed by 120,000 people (R-11) or an average of 530 gpcd. Projections of future water use must include considerations of present water use characteristics, effective metering, and other factors. Similarly, per-capita sewage generated has to be evaluated with an increase in population. The total quantity of water available in the service area compared to consumption rates will determine the total population this resource can support. The ability to treat sewage within the study area will also be pertinent.

Another important constraint on population is public policy and its implementation. The Sierra Pacific Power Company service area* population limit of 220,000 is currently considered a policy limit by the Regional Planning Commission. Environmental and land use constraints may affect distribution of population but not the regional population goal. Dynamic forces of economics, social change or other factors may create pressures for population totals different from the goal. In this case, policy implementation management becomes very important as public officials seek to guide urbanization according to adopted goals.

Forecasted Population

Several methods of population forecasting have been utilized in predicting growth patterns in Nevada. Among these have been the historical approach (reviewing past rates and predicting the same for the future) and the probability model approach (which weighs land use, resources, and other dynamic factors). Both techniques yield probable population in a study area at yearly time intervals.

---

*This service area as shown on Figure 2-2 differs in its geographic boundary from the study area covered in this report; the Company's service area constitutes approximately 53 percent of the study area.

Another projection method used by facilities planners depends upon average population per acre factors for various land uses based on past experience or public policy. Land use acreages are first determined for each service area; then acreage totals and population density factors are used to determine total population. This method usually suffers a bias in overstating future population because actual population densities achievable in practice are much lower than zoning and general plan policy would permit. However, since public land use policy does permit such theoretically high populations (often at variance with other adopted policy) and since it is much cheaper to build facilities initially large enough for ultimate populations than to expand later, facilities planners have understandably chosen to be high in estimating demand.

The consultant preparing the Areawide Water Quality Plan has updated the sewer service zones (W-4) and has estimated populations for each zone based on the Regional Planning Commisson's 1974 population update. Table 4-D, which is taken from the Areawide Plan, gives recent, past, future, and ultimate populations by sewerage zone, shown on Figure 4-4. Also shown are population totals expected to be tributary to the treatment plant in 1995. To the tributary population has been added a tourist equivalent population, in recognition of the substantial facility demand created by tourist visitors.

The consultant preparing the Facilities Plan for Expansion of Reno-Sparks Joint Water Pollution Control Plant (K-1) observed that the HUD-EPA/WCOG population estimate (W-4) was significantly higher than either the Commission's or the Division of Water Resources "envelopes". The service area population, when added to the tourist equivalent population, is approximately the same as the county population total without tourists. Since the areawide population estimates are relatively high compared to others, the facility consultant, Kennedy Engineers, adjusted the estimates by moving the HUD-EPA/WCOG 1995 forecasted county total population from 1995 ahead to 2000, in effect lowering the population estimates by about 27,000 at year 1995. These two population forecasts are shown on Figure 4-5 along with a number of other forecasts by private and public agencies. The Kennedy projection appears to fit historic data well, and although it is higher than both the Regional Planning Commission and Division of Water Resources estimates, it is very close to the University of Nevada Bureau of Business and Economic Research estimate.

TABLE 4-Da

FORECASTED POPULATION: ULTIMATE SERVICE AREA
POPULATION AND POPULATION TRIBUTARY TO RENO-SPARKS JWPCP

Sewer Zone	Ultimate Sewer Service Area Population					Tributary Population (a)
	1970	1973	1985	1995	Ultimate	1995
5	841	1,010	1,398	1,720	19,153	
4	13,450	15,420	21,985	26,448	44,242	26,448 R 6,430 T
6	7,433	8,035	11,456	13,781	27,470	13,781 R
9	1,614	1,859	2,651	3,189	3,786	3,189 R
10	2,374	2,738	3,904	4,696	7,636	4,696 R
7	8,254	8,608	12,273	14,764	28,697	14,764 R 11,900 R
11	5,741	6,412	9,142	10,998	11,423	10,998 R 2,440 T
13	115	182	259	312	916	312 R
Sub-Total	39,822	44,264	63,068	75,908	143,323	74,188 R 20,770 T
3	3,264	3,352	4,779	5,749	8,700	5,749
8	9,543	9,774	13,935	16,764	23,454	16,764 R 14,600 T
Sub-Total	12,807	13,126	18,714	22,513	32,154	22,513 R 14,600 T
1	1,558	1,947	2,776	3,339	25,161	3,339 R 75 T
2	11,287	12,581	17,938	21,579	47,973	21,579 R
Sub-Total	12,845	14,528	20,714	24,918	73,034	24,918 R 75 T
21	25,271	34,718	51,607	59,380	59,380	59,380 R 3,280 T
Sub-Total	25,271	34,718	51,607	59,380	59,380	59,380 R 3,280 T
25	5,346	8,520	11,796	14,509	35,800	
23	2,903	8,183	18,000	28,000	35,000	28,000
24	26	193	267	329	55,211	
22	226	2,951	4,387	5,241	39,226	5,241
Sub-Total	9,041	19,847	34,450	48,079	165,237	33,241
14	2,648	4,521	6,446	7,754	33,682	7,754 R 860 T
12	4,598	8,498	12,116	14,576	19,535	14,576 R 1,260 T
15	3,663	5,243	7,475	8,992	16,991	8,992 R 850 T
19	1,115	1,906	2,638	3,246	10,826	3,246 R
17	728	1,040	1,440	1,771	6,853	1,771 R
18	513	923	1,316	1,583	18,974	1,583 R 780 T

TABLE 4-Db

FORECASTED POPULATION: ULTIMATE SERVICE AREA
POPULATION AND POPULATION TRIBUTARY TO RENO-SPARKS JWPCP.
(continued)

Sewer Zone	Ultimate Sewer Service Area Population					Tributary Population[a]
	1970	1973	1985	1995	Ultimate	
28	1,655	2,765	3,827	4,709	59,390	
27	316	463	641	788	7,386	
26	1,063	1,673	2,316	2,849	6,585	
20	470	854	1,182	1,454	16,665	
15	715	906	1,254	1,543	24,157	1,543 R
Sub-Total	17,441	28,792	40,651	49,265	221,004	39,456 R 3,750 T
Total[b]	116,690	155,275	229,204 R 38,373 T 267,577	280,063	691,272	253,705 R 42,475 T 296,180

NOTES: (a) R = Resident population
T = Resident tourist population

(b) Population figures based upon Traffic Analysis Zone Study conducted by the State Highway Dept. and RPC.

Population Distribution

While design capacity of the JWPCP is dependent on forecasts of regional tributary population, design of interceptors is dependent on a more fine-grained local forecast of population distribution. In addition to the treatment plant, two sub-areas of the region are being considered in this report. These are areas tributary to the Cross-Town Interceptor and to the Lawton-Verdi Interceptor. It is in these areas that future population distributions will influence facilities planning. The Sun Valley Sewer service zone also deserves special evaluation due to its rapid recent growth pattern.

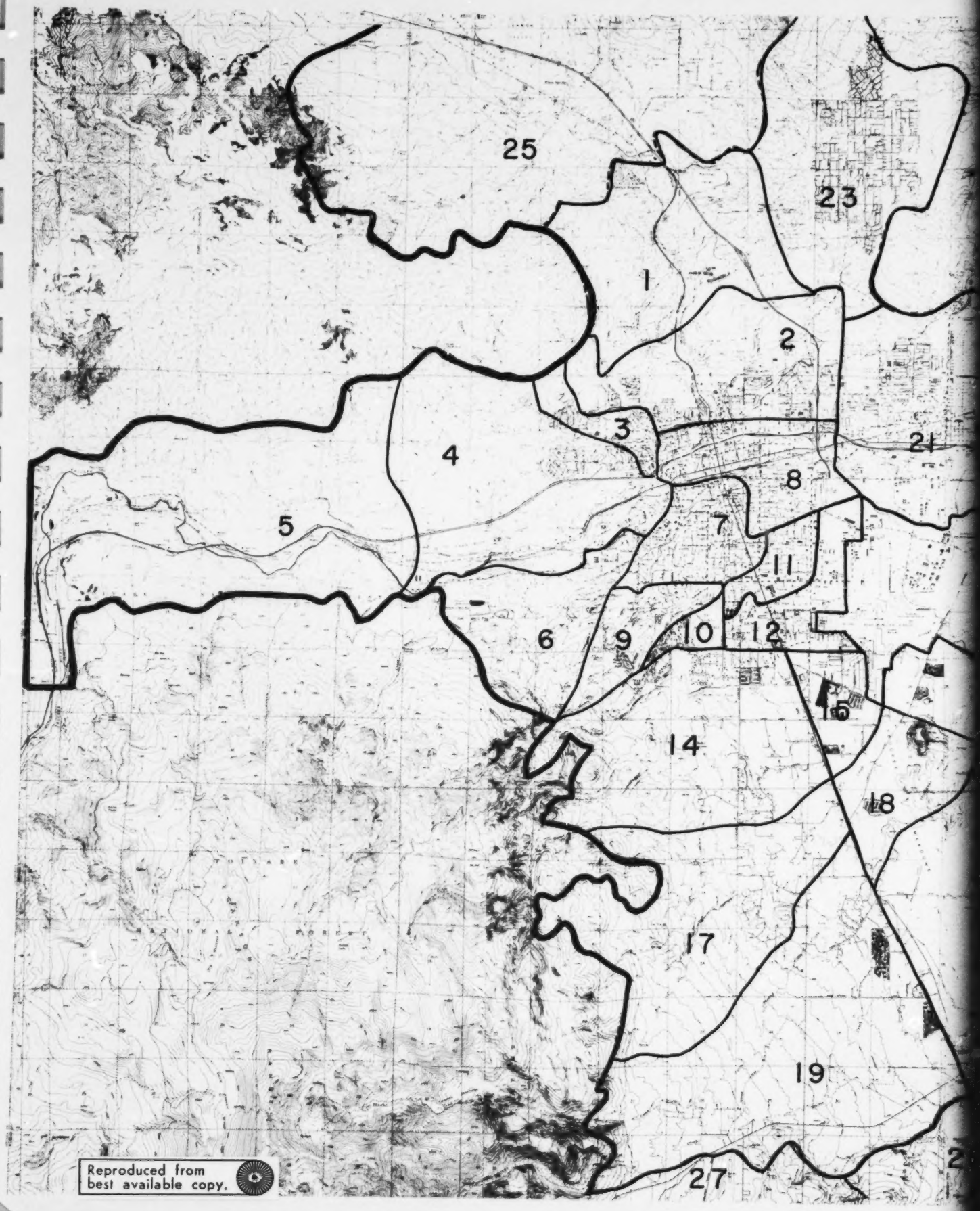
- West of Reno: Keystone-Lawton and Lawton-Verdi

  Highway 80, the Southern Pacific Railroad, and the Truckee River, all extending west from Reno through Verdi, have enhanced the development potential of this typically rural region.

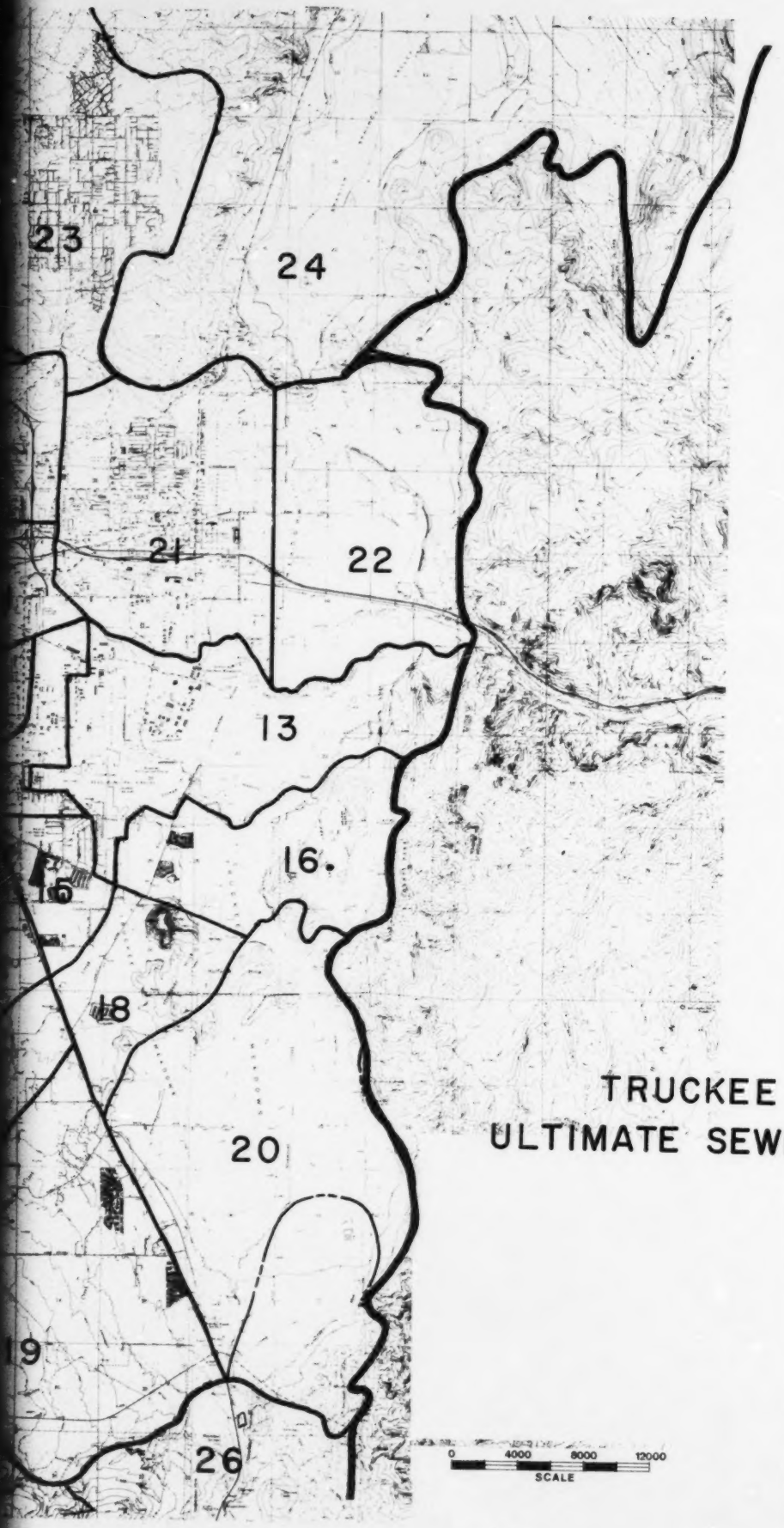
  The population reported in the Areawide Plan (W-1) for Verdi-Lawton, Lawton-Keystone and Mayberry-Idlewild sewer service zones for 1970 was 21,724. For 1995, these three zones are forecasted by WCOG to contain 41,949 people and the 1995 JWPCP tributary population is forecasted to be 46,659 people--this excludes Verdi but includes 6,430 tourist equivalent. The ultimate population is forecasted to be 90,865 in the Areawide Plan. Other estimates have ranged as high as 139,000 for the approximate area of these three service zones (T-1, R-1, S-1, T-3, T-4).

- Sun Valley

  Sun Valley, north of Sparks, also deserves special attention because plans are under consideration to carry sewage generated from the area to the Reno-Sparks JWPCP via the proposed Spanish Springs Interceptor. The 1940-1950 decade was the first in which development occurred in Sun Valley with population climbing from 0 to 300 (W-6). A 1975 special census indicates a current population of 11,000 (W-6). Other estimates of 1975 population range from 9,000 to 9,800 (S-16, W-6). Forecasts range between 28,000 (W-6) and a maximum year 2000 population of 35,000 (W-6). The former is a Planning Commission forecast assuming current zoning. The latter is a Water District estimate assuming higher density zoning.

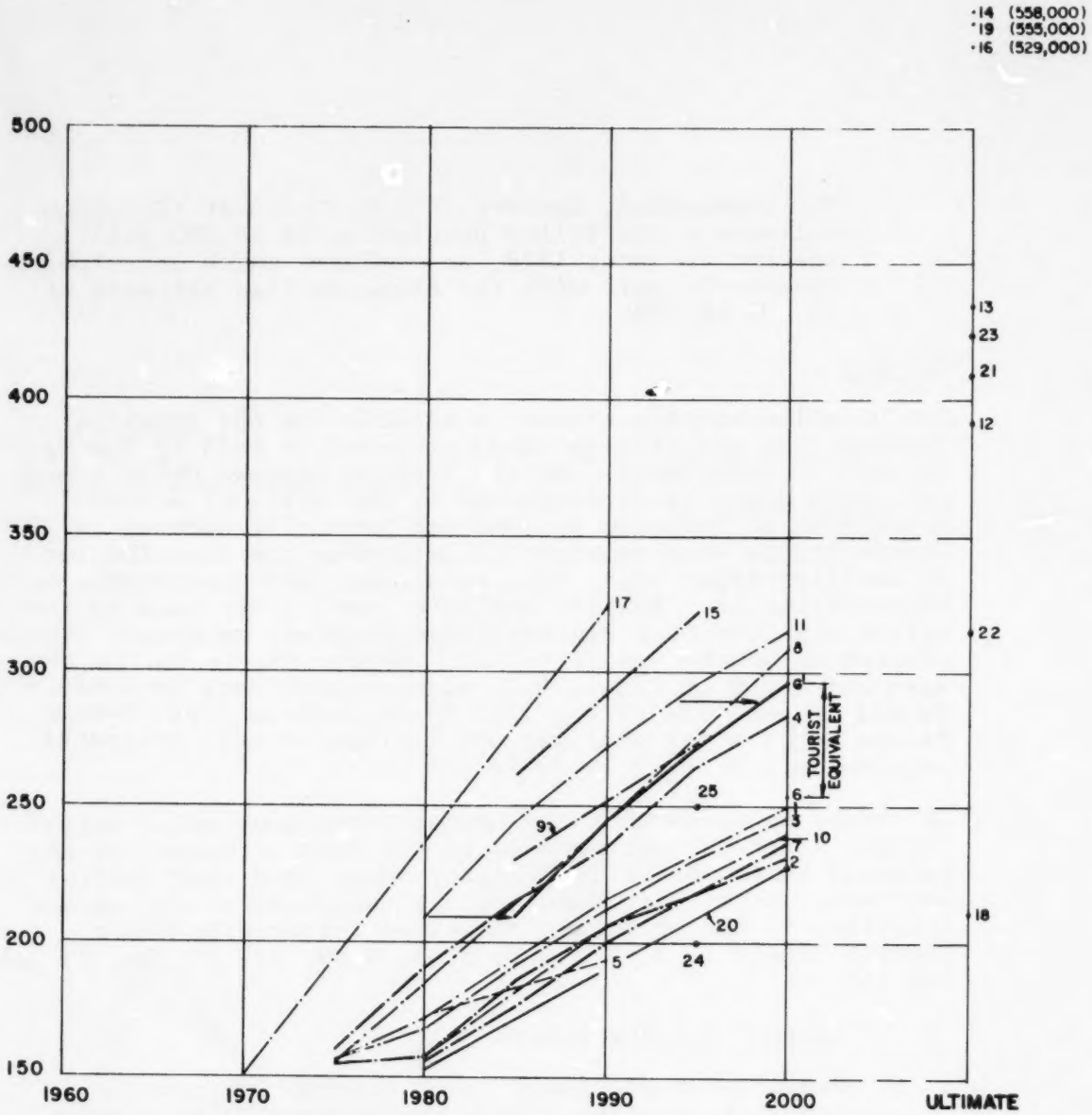


Reproduced from best available copy.



TRUCKEE MEADOWS
ULTIMATE SEWER SERVICE ZONES

Figure 4-4



County	1	Department of Water Resources - High (S-12)
County	2.	Department of Water Resources - Low (S-12)
County	3.	RPC (R-6, R-7, R-25)
County	4.	Bur Bus & Econ Res, UofN,R (B-14)
County	5.	RERC for RENOvation (R-15)
County	6.	JWPCP Facility Plan, Resident (K-1)
Sewer Serv Area	6.	President and tourist (K-1)
County	7.	Dept. Commerce, Bur of Econ Anal (C-32)
County	8.	Historic Trend (4.2 %/yr)
County	9.	HUD-EPA/WCOG. W Q. Mgmt Plan (W-1)
County	10.	State Water Plan (S-12)
Sewer Serv Area	11.	HUD-EPA/WCOG. W Q. Mgmt Plan (W-1)
Ult Serv Area	12.	RPC-Conservation & Pop. Plan, Washoe County I (R-25)
Ult Serv Area	13.	RPC-Conservation & Pop. Plan, Washoe County II (R-25)
Ult Serv Area	14.	RPC-Conservation & Pop. Plan, Washoe County III (R-25)
Ult Serv Area	15.	HUD-EPA/WCOG. W Q. Mgmt Plan (W-1)
County	16.	WCOG Public Facilities "Element" of Gen. Plan (R-11)
County	17.	State Division of Highways Trans. Study (H-4)
SPPC Serv Area	18.	RPC Reported SPPC Service Area Limit (R-25)
County	19.	RPC Proposed Conservation & Pop. Plan, Washoe County I (R-6)
SPPC Serv Area	20.	SPPC 1971 Planning Report (S-13)
	21.	TME 1966.68 (T-3)
County	22.	RPC Hydrographic Regions at 50 percent use of water resource (R-26, B-1)
	23.	WCOG Public Facilities "Element" of Gen. Plan (R-11)
	24.	State Div. of Highways - RPC 1976 Working Forcast - Low
	25.	State Div. of Highways - RPC 1976 Working Forcast - High

HISTORIC & FORECASTED POPULATION

FIGURE 4-5

Preceding page blank

The Commission, however, has stated that it currently believes a Sun Valley population of 16,000 will be reached in about 1979, an estimate which corresponds reasonably well with the Areawide Plan estimate of 18,000 in 1985.

Housing

Two detailed housing studies available are the Areawide Housing Plan and Program (W-6) prepared in 1975 by the Washoe Council of Government, and the Truckee Meadows Urban Transportation Study (E-8) conducted by the State of Nevada Department of Highways in 1964 and partially updated in 1974. Census tracts were examined to determine the distribution of dwelling type, cost, age, condition, and demographic characteristics. Traffic analysis zones (TAZ) used by the Nevada Department of Highways were examined to obtain expected changes in housing units by TAZ. Census tracts in the study area are shown on Figure 4-3, with related data in Table 4-C. To aid in analysis of the 1995 Sewer Service Area, Census Tracts and Traffic Analysis are aggregated into geographic regions as set forth in Table 4-E.

It should be noted that the Lawton-Verdi geographic region (Census Tract 23) corresponds to the area tributary to the proposed Lawton-Verdi Interceptor Sewer, and that Central, Northwest, West, East Reno and the Lawton-Verdi region are tributary to the proposed Cross-Town Interceptor Sewer (Census Tracts 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 23, 24 and 25).

- Current Housing Traits

  Examination of census tract information reveals important housing trends in the Reno SMSA. Sparks, for example, contains 40 percent of all SMSA single family housing and 33.7 percent of all SMSA new residential units, although it is approximately one-fourth the size of Reno.

  Local concentrations of the elderly, concentrations of below-median-income families, and racial mixtures are also illustrated for census tracts in Table 4-C. Information regarding demolition of housing, condition of housing, and type of housing being constructed is shown in Table 4-C and Table 4-F.

TABLE 4-E

GEOGRAPHIC AGGREGATION OF
CENSUS TRACTS AND TRAFFIC ZONES

Geographic Region	Census Tracts	Traffic Zones
Central Reno	1, 5, 6, 12	457, 467, 477, 487, 440, 444, 445, 447, 452, 424, 453, 454, 417, 418, 419, 420, 421, 422, 436, 437, 438
Northwest Reno	13, 14, 24, 25	400, 402, 404, 408, 409, 442, 435
Northeast Reno	15, 16, 17, 18	405, 406, 407, 410, 411
West Reno	3, 4	429, 430, 431, 446, 448, 449
East Reno	2, 7, 8, 9	305, 423, 425, 432, 433, 450, 451
Southeast Reno	21, 22	434, 109, 110, 111, 201, 203, 306, 307, 311, 313, 426
Southwest Reno	10, 11	416, 428, 301, 203, 303, 304, 208, 309, 310, 312, 314, 315, 316
Lawton-Verdi	23	414, 415, 439
Sun Valley	27	101, 403
Sparks	19, 20, 28, 29 30, 31	102, 103, 104, 105, 106, 107, 108, 112, 113, 114, 412, 427, 441, 443

TABLE 4-F

TYPE OF RESIDENTIAL STRUCTURES CONSTRUCTED
1970-1975

Geographic Region	Total New Single Family Units Constructed	Total All New Units Constructed	Total Residential Structures (1975)
Central Reno	17	422	1164
Northwest Reno	490	838	3373
Northeast Reno	27	565	1730
Lemmon Valley	546	570	780
West Reno	91	332	2397
East Reno	39	497	1688
Southeast Reno	705	1516	1978
Southwest Reno	656	1954	1411
Lawton-Verdi	311	364	
Sun Valley	72	99	209
Sparks	1969	3630	6065

Source: (W-6)

- Family Size

Population forecasts indicate a 28 percent increase for the study area over the next 10 years. National trends toward smaller family size have been established historically, and are summarized below:

Year	1900	1910	1920	1930	1940	1950	1960	1970
Population per Household	4.76	4.54	4.34	4.11	3.77	3.52	3.38	3.20

Washoe County statistics of 3.71 persons/household in 1930, and 3.3 persons/household in 1975 are in keeping with this national trend.

- New Housing Unit Planning

Future housing required as determined by WCOG is 1839 new units per year. Family income is a dominate factor in the planning of new dwelling units since it determines the ability of prospective buyer to purchase a new home. Current income profiles indicate that less than 46 percent of Reno families can meet necessary income requirements to purchase an average priced house.

Family incomes have been divided into four groups (W-6) with each having an associated percentage of total population. The number of new housing units required for each income group was then determined and is presented in Table 4-G.

TABLE 4-G

SERVICE AREA HOUSING NEEDS

Income Range 1	% Population	Needed Annual New Dwellings
Very low income	19	349 units
Lower income	18	332 units
Moderate income	19	349 units
Above median	44	809 units
	TOTAL =	1839 Units/year needed

Source: (W-6)

- Housing Distribution by Population Characteristics

  Land use becomes increasingly important when locations for special income group housing are sought. Senior citizens comprise 8.5 percent of the SMSA population, with 26 percent having incomes below poverty level.

  Blacks account for 1.6 percent of the SMSA population with a median income of $6,619 per year. Twenty-five percent of family units in the Reno SMSA have incomes below $5,000 per year. New land developments currently in planning or construction contain no units in a price range affordable by this portion of the population. Although 26.8 percent of the current housing inventory is priced below $30,000, much of this inventory is older housing in neighborhoods designated for urban renewal.

- Forecasted Housing

  The Truckee Meadows Urban Transportation Study (H-3) covering a 26 year future period, corresponds well with land use data evaluated earlier. Forecasted annual percent changes in housing units are tabulated in Table 4-H.

TABLE 4-H

ANNUAL CHANGES IN DWELLING UNITS

Geographic Region	Annual Dwelling % Change
Central Reno	- 1.27%
Northwest Reno	+15.73
Northeast Reno	+ 1.54
West Reno	+ 3.04
East Reno	+ 1.5
Southeast Reno	+39
Southwest Reno	+24.4
Lawton-Verdi	+19.6
Sun Valley	+25.7
Sparks	+10.4

Source: (H-3)

Central Reno is expected to experience a decline (-1.27 percent/year) in residential structures as downtown redevelopment progresses. This decline is also reflected in the percent of old structures demolished, shown in Table 4-C. Regions tributary to the sewage project are forecasted to have greater percentages of residential dwellings as urbanization expands, as shown in Table 4-H.

Economic Conditions

The economic structure and employment base are important to the current study insofar as they support population in the area and help determine the rate of economic and population growth.

Historically, employment in Nevada has been based on mining, agriculture, and to a lesser extent, transportation. Agriculture continued as a significant influence through the first half of this century with mining having a brief revival in the first

two decades. Since the late 1930's, trade and service industries have become a dominant factor in the economy of Nevada; other strong sectors are transportation, construction, and in recent years, warehousing and government.

- Economic Structure and Employment

Table 4-I gives employment by industrial classification from 1940 to 1975 and the percentage distribution of each classification for the State of Nevada. Figure 4-6 aggregates the percentage distribution of employment by industrial classification to total employment in the State of Nevada. Sources for these data are varied and not entirely consistent; however general distributions and trends are evident.

The increasing importance of the service and trade industries including tourism, gaming and entertainment, construction and government in Nevada is evident from this data. A corresponding reduction in the importance of agriculture and mining over this period can also be noted. As shown on Table 4-I, in 1940, agriculture and mining shared a balanced position with transportation-communication-public utilities, trade and service sectors, with a total employment of 41,300. By 1975, agriculture and mining had both slipped to 1.5 percent of the work force. Trade service, and government clearly dominated, making up 76.9 percent of the work force.

Washoe County shows a similar employment distribution pattern to the state, as shown in Table 4-J and Figure 4-7. Data for Washoe County includes the entire Reno SMSA. This is much larger than the 1995 service area considered in this study. However, the service area includes approximately 85 percent of the Reno SMSA population and nearly all of the employment.

The differences between the state and Reno SMSA employment characteristics include a somewhat greater dominance of the service and trade industry in the county, large share of government workers, larger transport, communication and utilities sector and larger construction sector than the state as a whole. These are consistent with the fact that most of the tourism (large basis of service and trade industries) is concentrated in Washoe County (Reno) and Clark

TABLE 4-I

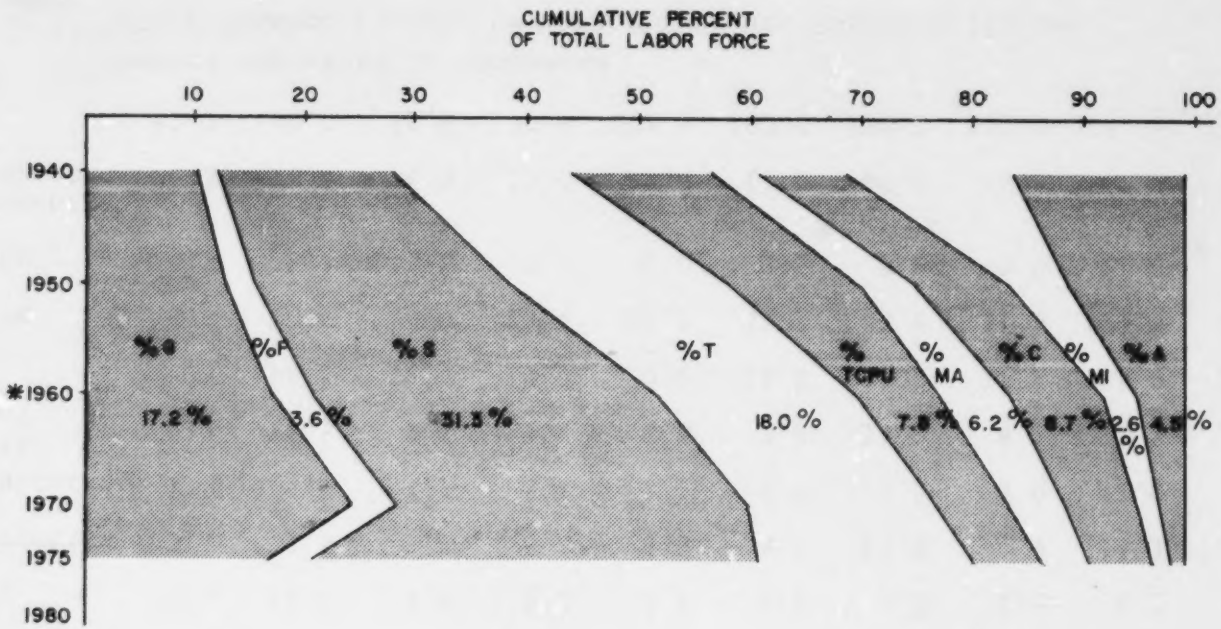
STATE OF NEVADA EMPLOYMENT BY INDUSTRIAL CLASSIFICATION

Industry	1940	Percent	1950	Percent	1960	Percent	1970	Percent	1975	Percent
Agriculture	6.4	15.6	6.8	10.7	5.1	4.5	4.4	2.2	4.1	1.5
Mining	6.3	15.2	3.3	5.2	2.9	2.6	3.5	1.8	4.0	1.5
Construction	3.1	7.5	5.5	8.6	9.8	8.7	13.9	6.9	16.2	5.7
Manufacturing	1.9	4.5	3.3	5.1	7.0	6.2	9.5	4.9	12.0	4.3
TCPU[b]	5.2	12.5	7.4	11.6	8.8	7.8	13.5	6.7	17.2	6.1
Trade	6.8	16.5	12.6	19.9	20.2	18.0	34.2	17.1	54.9	19.6
Service	6.4	16.0	14.9	23.4	35.2	31.3	63.6	31.8	113.7	40.5
Finance	0.7	1.7	1.6	2.5	4.0	3.6	7.8	3.9	11.3	4.0
Government & Unreported	4.3	10.4	8.3	13.0	19.4	17.2	49.2	24.6	47.2	16.8
Total	41.3	100.0	63.6	100.0	112.4	100.0	200.3	100.0	260.6	100.0

NOTES: (a) Numbers expressed in thousands

(b) TCPU = Transportation, Communications and Public Utilities

Source: (C-15, C-20, L-3)



* SEE 1960 TABLE

LEGEND:

A = AGRICULTURE
MI = MINING
C = CONSTRUCTION
MA = MANUFACTURING

TCPU = TRANSPORTATION, COMMUNICATION, PUBLIC UTILITIES
T = TRADE
S = SERVICE
F = FINANCE, REAL ESTATE, INSURANCE
G = GOVERNMENT & NOT REPORTED

HISTORIC NEVADA EMPLOYMENT DISTRIBUTION

Source: (Table 4-I)

Figure 4-6

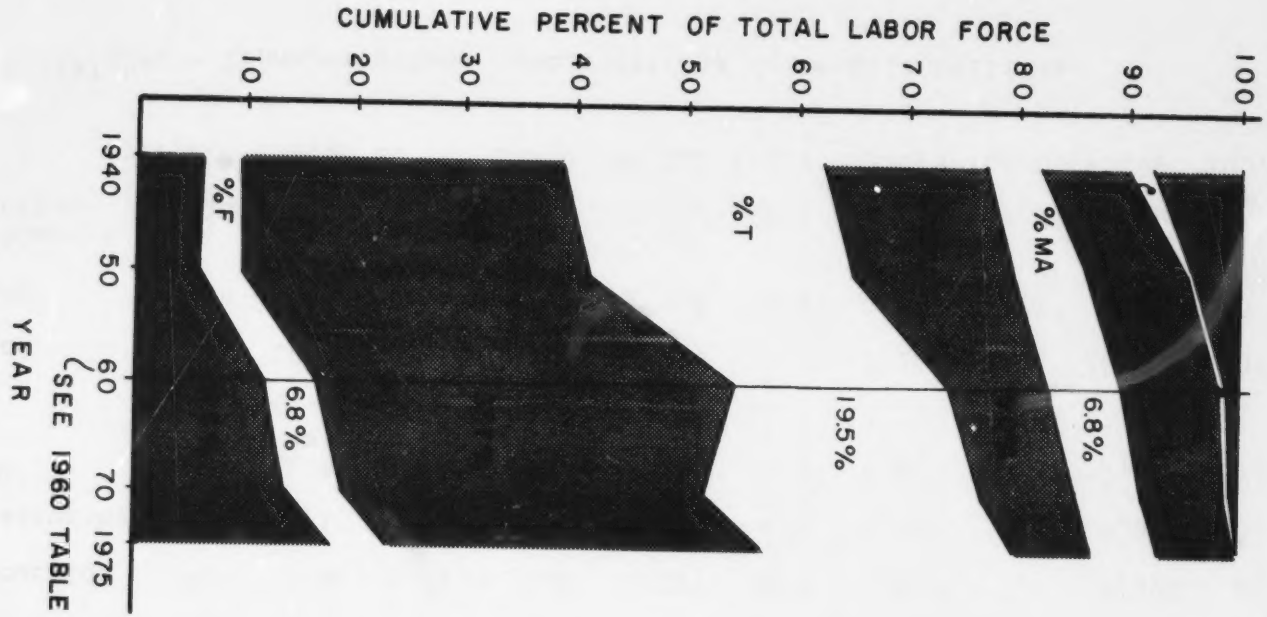
TABLE 4-J

WASHOE COUNTY EMPLOYMENT DISTRIBUTION

Industry	1940	Percent	1950	Percent	1960	Percent	1970	Percent	1975	Percent
Agriculture	947	7.9	902	4.3	596	1.6	644	1.2	100	-
Mining	276	2.3	101	0.5	149	0.5	318	0.6	300	0.5
Construction	937	7.8	1,833	8.8	3,167	8.7	3,830	7.2	5,300	6.8
Manufacturing	611	5.1	1,495	7.2	2,477	6.8	3,057	5.8	4,600	5.9
TCPU[a]	1,744	14.6	2,941	14.2	3,287	9.0	4,607	8.7	5,900	7.6
Trade	2,795	23.4	4,930	23.8	7,132	19.5	13,310	25.0	17,700	22.7
Service	3,479	29.2	6,524	31.5	13,758	37.7	17,266	32.6	26,200	33.7
Finance	424	3.5	841	4.0	1,756	6.8	3,007	5.7	4,000	5.1
Government & Unreported	715	6.0	1,173	5.6	4,205	11.5	6,980	13.2	13,800	17.7
Total	11,928	100.0	20,740	100.0	36,527	100.0	53,019	100.0	77,900	100.0

NOTES: (a) TCPU = Transportation, Communications and Public Utilities

Source: (C-15, C-18, E-16)



A = AGRICULTURE
MI = MINING
C = CONSTRUCTION
MA = MANUFACTURING

TCPU = TRANSPORTATION, COMMUNICATION, PUBLIC UTILITIES
T = TRADE (WHOLESALE & RETAIL)
S = SERVICE
F = FINANCE, REAL ESTATE, INSURANCE
G = GOVERNMENT & NOT REPORTED

HISTORIC WASHOE COUNTY EMPLOYMENT DISTRIBUTION

Source: (Table 4-J)

Figure 4-7

County (Las Vegas); there is also a concentration of government offices in Reno, in addition to the main campus of the University of Nevada. The Reno area is becoming a center of warehousing, generating employment for the transportation and construction sectors.

Figure 4-8 shows the number of firms and employees in the Reno SMSA in 1974 by industrial classification. This data emphasizes the current structure of the economy in Reno, dominated by trade, service, and government. The state has made an effort to encourage a more balanced economy since the growth of the tourism-entertainment-gaming industry by offering tax advantages and taking advantage of location, labor force, cost advantages and transportation network to encourage growth of warehousing and manufacturing.

- Changes in Employment Patterns

The rate of change of employment within each industrial classification and total employment is shown for Nevada in Figure 4-9 and for Washoe County in Figure 4-10. Generally the patterns of change are similar in the county and state and correspond to the increasing importance of trade, service, and government and the declining influence of mining and agriculture. Total employment has increased 534 percent in the state and 555 percent in Washoe County from 1940 to 1975.

The distribution of employment within Washoe County with respect to the State of Nevada has remained relatively stable in most categories over the past 15 years. Table 4-K and Figure 4-11 present data showing the percentage of statewide employees in each of the nine industrial classifications who are located in the Reno SMSA for 1960, 1970, and 1975.

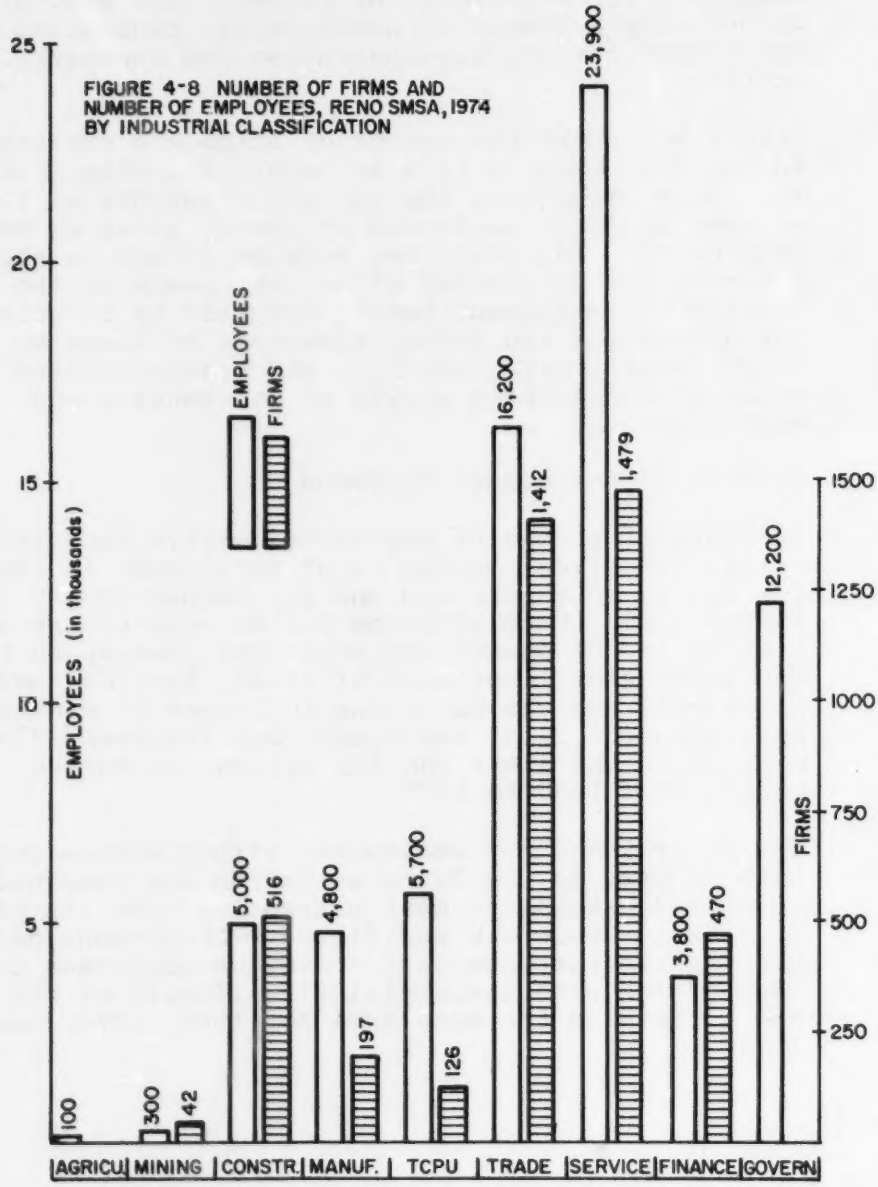
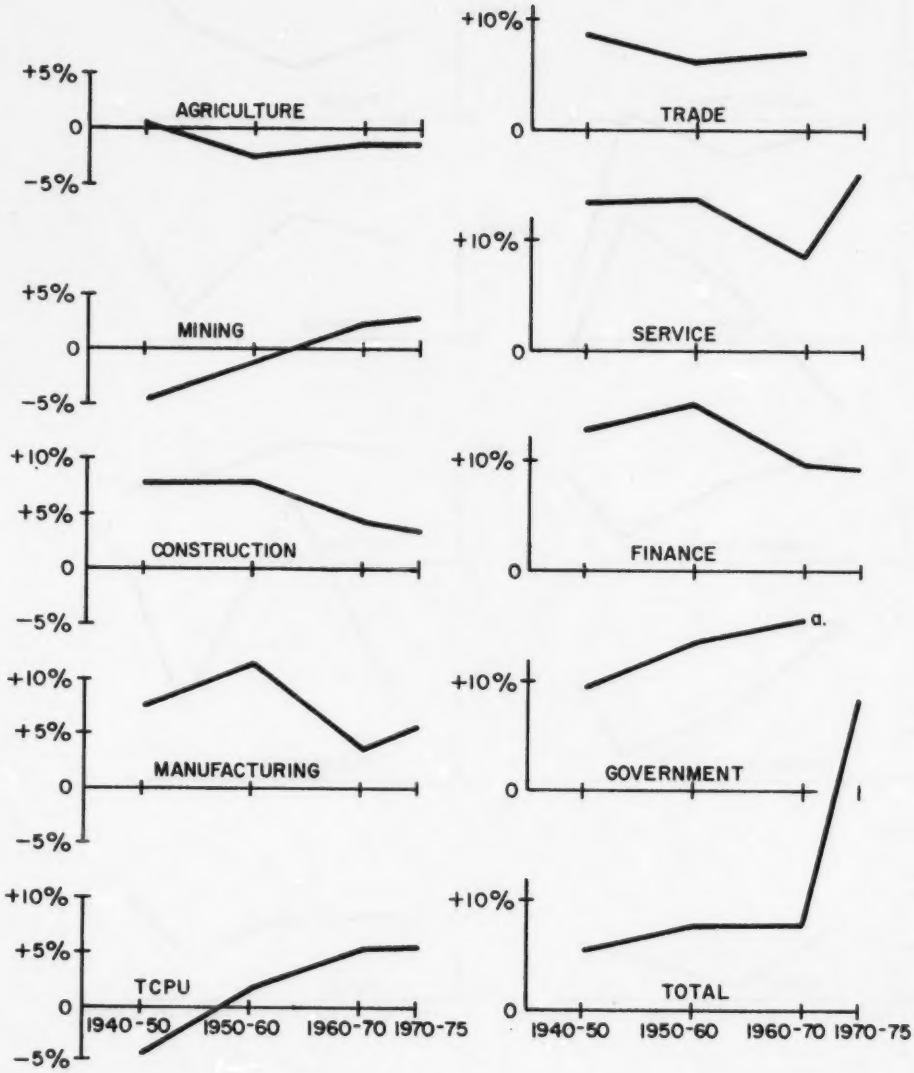


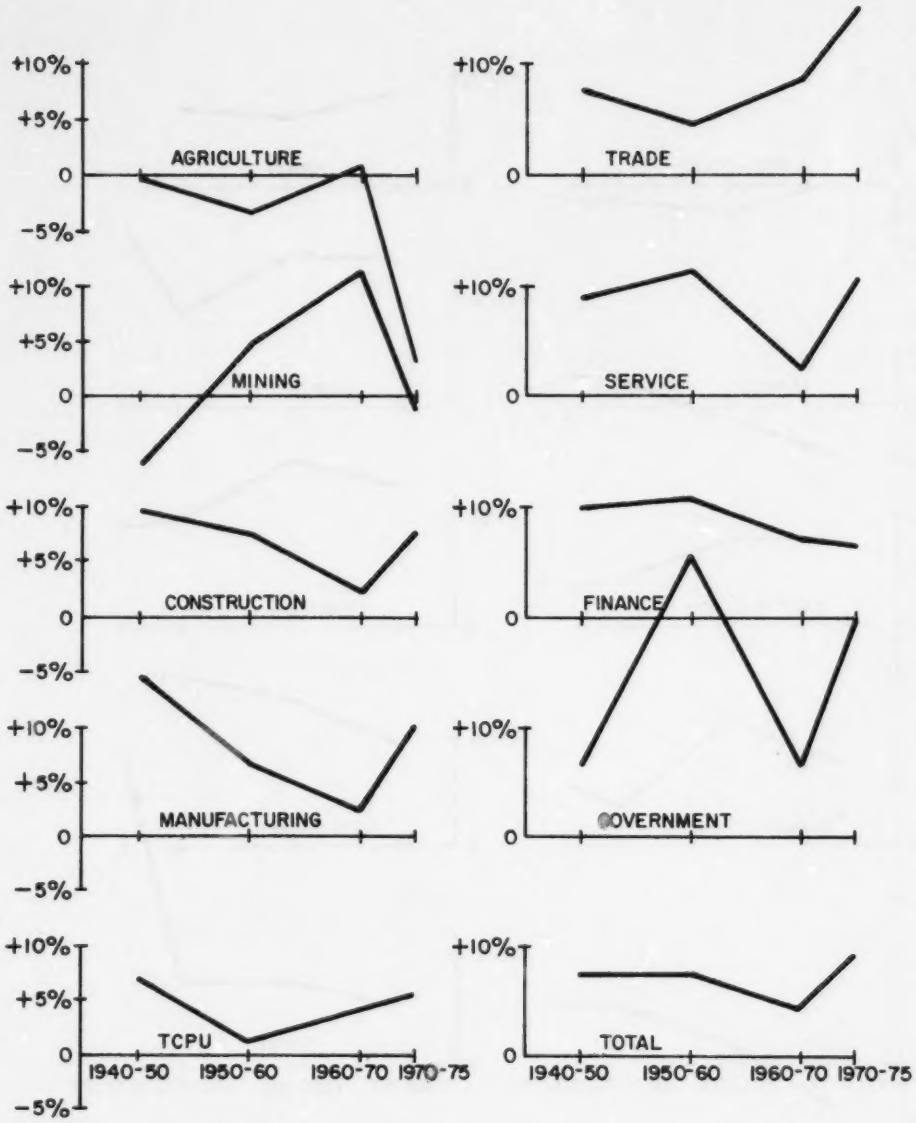
FIGURE 4-8 NUMBER OF FIRMS AND NUMBER OF EMPLOYEES, RENO SMSA, 1974 BY INDUSTRIAL CLASSIFICATION



YEARLY AVERAGE DECENNIAL RATE OF
CHANGE OF NEVADA EMPLOYMENT BY
INDUSTRIAL CLASSIFICATION

Source: (Table 4-I)

Figure 4-9



YEARLY AVERAGE DECENNIAL RATE OF
CHANGE OF WASHOE COUNTY EMPLOYMENT BY
INDUSTRIAL CLASSIFICATION

Source: (Table 4-J)

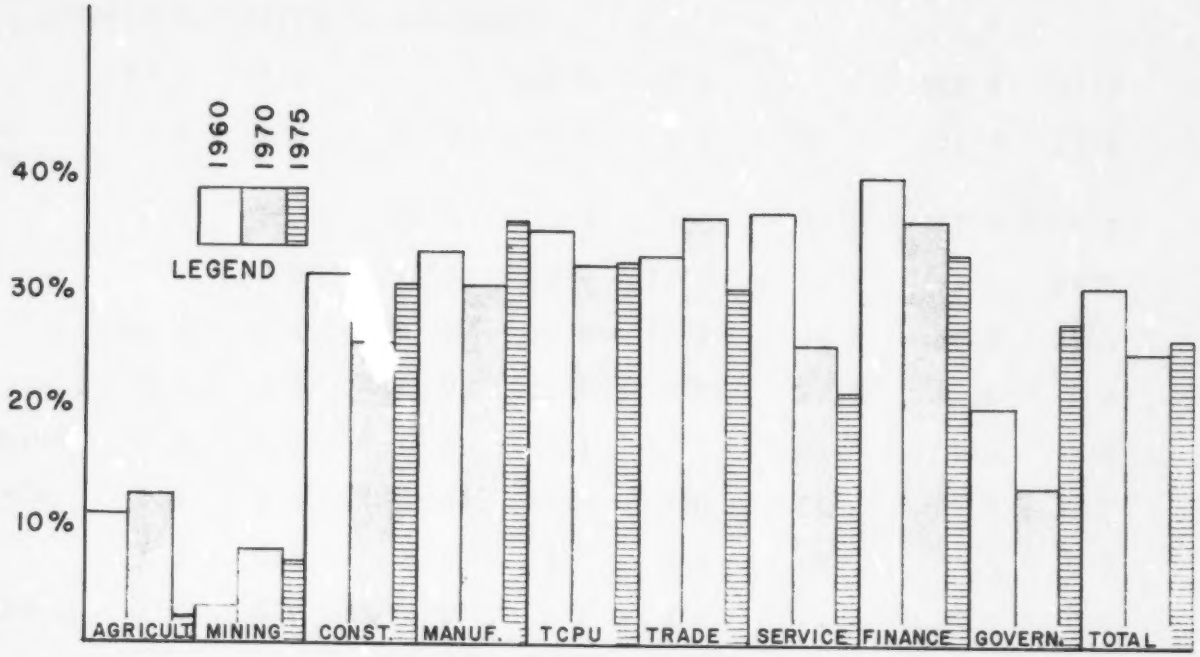
Figure 4-10

TABLE 4-K

WASHOE COUNTY/STATEWIDE EMPLOYMENT DISTRIBUTION[a]
(Percent of Nevada Industrial Classification Employees in Washoe County)

Industry	1960			1970			1975		
	State	County	Percent	State	County	Percent	State	County	Percent
Agriculture	5.1	0.6	11.8	4.4	0.6	13.6	4.1	0.1	2.4
Mining	2.9	0.1	3.4	3.5	0.3	8.6	4.2	0.3	7.5
Construction	9.8	3.2	33.6	13.9	3.8	27.3	16.2	5.3	32.7
Manufacturing	7.0	2.5	35.7	9.5	3.1	32.6	12.0	4.6	38.3
TCPU[b]	8.8	3.3	37.5	13.5	4.6	34.1	17.2	5.9	34.3
Trade	20.2	7.1	35.2	34.2	13.3	38.9	54.9	17.7	32.2
Service	35.2	13.8	39.2	63.6	17.3	27.2	113.7	26.2	23.0
Finance	4.0	1.7	42.5	7.8	3.0	38.5	11.3	4.0	35.4
Government & Unreported	19.4	4.2	21.6	49.2	7.0	14.2	47.2	13.8	29.2
Total	112.4	36.5		200.3	53.0		280.6	71.9	

NOTES: (a) Numbers expressed in thousands
(b) TCPU = Transportation, Communications and Public Utilities



PERCENT OF ALL NEVADA EMPLOYEES IN WASHOE COUNTY
BY INDUSTRIAL CLASSIFICATION

Figure 4-11

An indication of the supply and demand for labor in Washoe County is given from the data in Table 4-L. This data compares the job openings and applicants in broad occupational groups (State of Nevada Job Services Office, Reno Area, Third Quarter, 1975).*

Generally, the competition for jobs is high. It has been observed that there is a significant latent labor force in Reno resulting from the fact that the industrial employment base in the area is narrow, but that many people have been willing to relocate in Reno, accepting jobs for which they were not originally trained. If industries locating in Reno offer jobs in more varied occupations, many people in the service-dominated employment sector may be available to work in other occupations. There were approximately 4200 private firms in the Reno SMSA in 1974, employing an average of 13 employees; only 74 employers had 100 or more employees.

Figure 4-12 compares unemployment data for Reno, the state and the nation for the period 1960 through 1975. The unemployment rate in the Reno SMSA has consistently been lower than that for Nevada, but has been generally higher than the national average. This perhaps reflects the vulnerability of the tourist-based service and trade industry during the energy crisis and recession of the mid 1970's. However, the diversifying Reno economy performed better during this period than the State of Nevada as a whole.

Over the past 10 years, earnings in the Reno SMSA have consistently been higher than for comparable occupations nationwide, with the exception of the finance real estate, and insurance group and service industries.

---

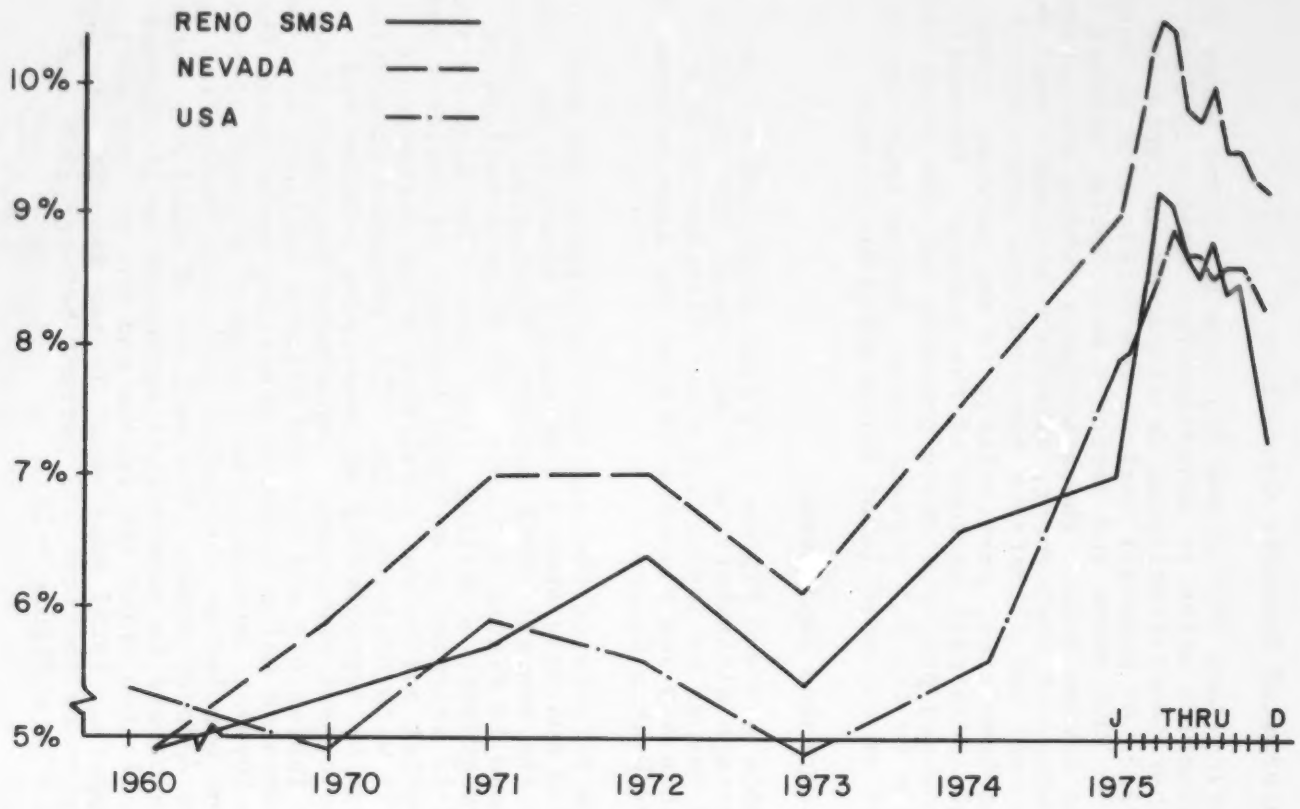
*This data has some minor distortions resulting from seasonal employee placement several times in the quarter; it only includes those openings/applicants using the State Job Service. However, it is a reliable indicator of current employment market conditions in the Reno SMSA.

TABLE 4-L

JOB APPLICANTS AND OPENINGS RENO AREA,
3rd QUARTER 1975

Occupation Groups	Applicants	Job Openings
Professional/technical/ managerial	971	108
Clerical	1,482	661
Sales	572	180
Domestic service	81	465
Other service	1,883	988
Farm oriented	117	132
Processing	51	22
Machine trades	425	136
	300	148
Structural	895	396
Transportation/warehousing/ miscellaneous	957	852
Total	7,734	4,088

Source: (E-10)



ANNUAL AVERAGE AND SEASONALLY ADJUSTED
UNEMPLOYMENT (LABOR FORCE)

Source: (E-10)

Figure 4-12

- Forecasted Economic Conditions

During late 1975 a new 350 room hotel was under construction which is scheduled for opening in June 1976. Other tourist-oriented developments in tentative stages of proposal include two hotels with an estimated 1700-2000 rooms and Harrah's Auto World, planned for the Lawton area. These projects, which are direct sources of employment, stimulate secondary employment as well and illustrate the continued expansion of the Reno area, particularly in the service, trade, and industrial sectors of the economy. Currently proposed projects could probably cut the unemployment rate to the 4.5 percent range, before opportunities for an expanded labor force would be created.

- Forecasted Employment

Table 4-M and Figure 4-13 give projected and percentage distributions of employment for the State of Nevada by industrial classification to 2000. Table 4-N and Figure 4-14 give the same information for Washoe County.

The results of the economic-employment and population analysis show a consistency which is important to the overall JWPCP design. Population forecasts shown in Figure 4-5 were made using a variety of demographic modelling techniques. The Kennedy Study (K-1) selected a modified forecast of resident and tourist equivalent population which corresponds well with historic data. This expected population must be supported by an underlying economy and employment structure. Employment forecasts shown in Tables 4-M and 4-N and Figures 4-13 and 4-14 were generated using economic modelling techniques. The employment forecasted will support a range of resident population consistent with that forecasted by the Kennedy study. The variety of modelling techniques are in substantial agreement on the future population which the region and the economy will support. Total employment in the Reno SMSA is projected to increase 147 percent between 1975 and 2000 (see Figure 4-15).

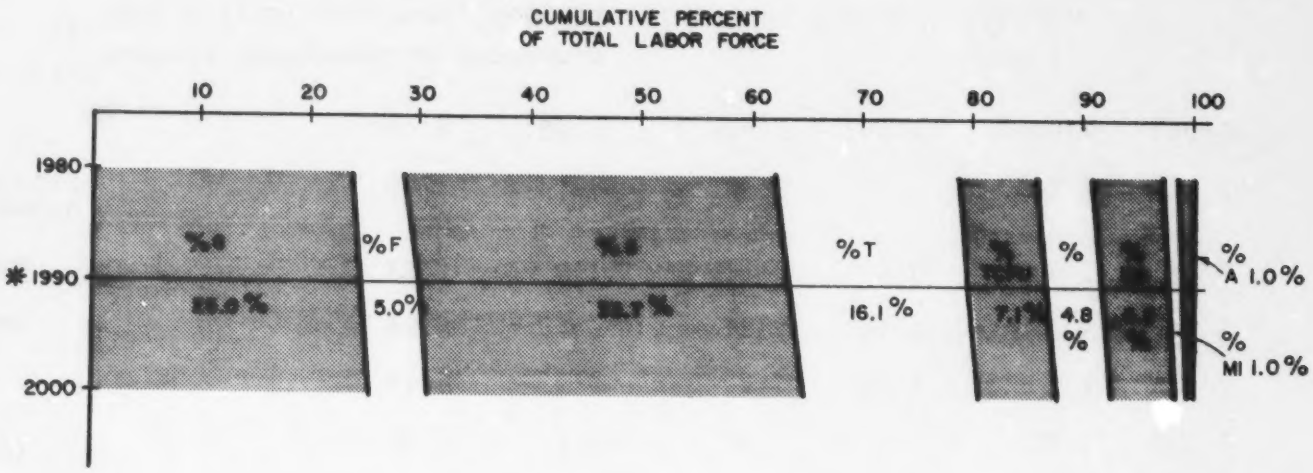
TABLE 4-M

FORECASTED NEVADA EMPLOYMENT DISTRIBUTION[a]

Industry	1980	Percent	1990	Percent	2000	Percent
Agriculture	4.4	1.5	4.0	1.1	3.7	0.9
Mining	3.5	1.3	3.3	1.0	3.2	0.8
Construction	18.3	6.4	21.2	6.2	23.6	5.8
Manufacturing	13.9	4.9	16.6	4.8	19.0	4.7
TCPU[b]	19.8	7.0	24.4	7.1	28.5	7.1
Trade	47.4	16.7	55.4	16.1	63.3	15.7
Service	95.3	33.5	116.4	33.7	137.5	34.1
Finance	13.3	4.7	17.2	5.0	21.1	5.2
Government & Unreported	68.3	24.0	86.0	25.0	103.7	25.7
Total	284.2	100.0	344.5	100.0	403.6	100.0

NOTES: [a]Numbers expressed in thousands
[b]TCPU = Transportation, Communications and Public Utilities

Source: (C-21)



✱ SEE 1990 TABLE

LEGEND:

A = AGRICULTURE
MI = MINING
C = CONSTRUCTION
MA = MANUFACTURING

TCPU = TRANSPORTATION, COMMUNICATION, PUBLIC UTILITIES
T = TRADE
S = SERVICE
F = FINANCE, REAL ESTATE, INSURANCE
G = GOVERNMENT & NOT REPORTED

FORECASTED NEVADA EMPLOYMENT DISTRIBUTION

Source: (Table 4-M)

Figure 4-13

TABLE 4-N

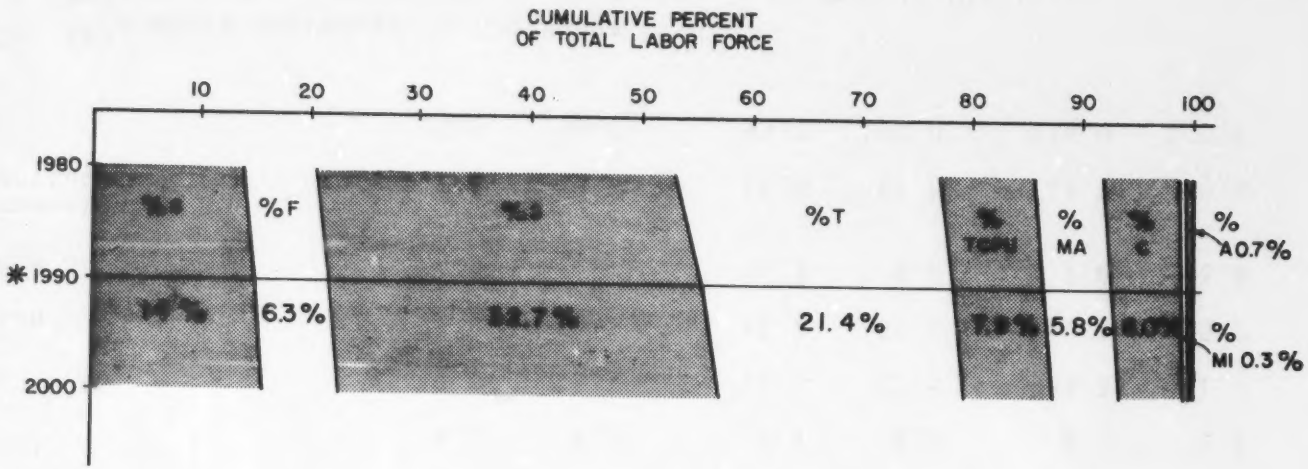
FORECASTED WASHOE COUNTY EMPLOYMENT DISTRIBUTION[a]

Industry	1980	Percent	1990	Percent	2000	Percent
Agriculture	0.7	0.9	0.7	0.7	0.6	0.5
Mining	0.3	0.4	0.3	0.3	0.3	0.3
Construction	5.0	6.7	6.0	6.3	6.8	5.9
Manufacturing	4.7	6.3	5.8	6.1	6.7	5.8
TCPU[b]	6.5	8.7	7.9	8.3	9.4	8.2
Trade	17.8	23.7	21.4	22.5	25.1	21.9
Service	24.9	33.2	32.7	34.4	40.4	35.2
Finance	4.8	6.4	6.3	6.6	7.8	6.8
Government & Unreported	10.3	13.7	14.0	14.8	17.7	15.4
Total	75.0	100.0	95.1	100.0	114.8	100.0

NOTES: (a) Numbers expressed in thousands

(b) TCPU = Transportation, Communications and Public Utilities

Source: (C-21)



✱ SEE 1990 TABLE

LEGEND:

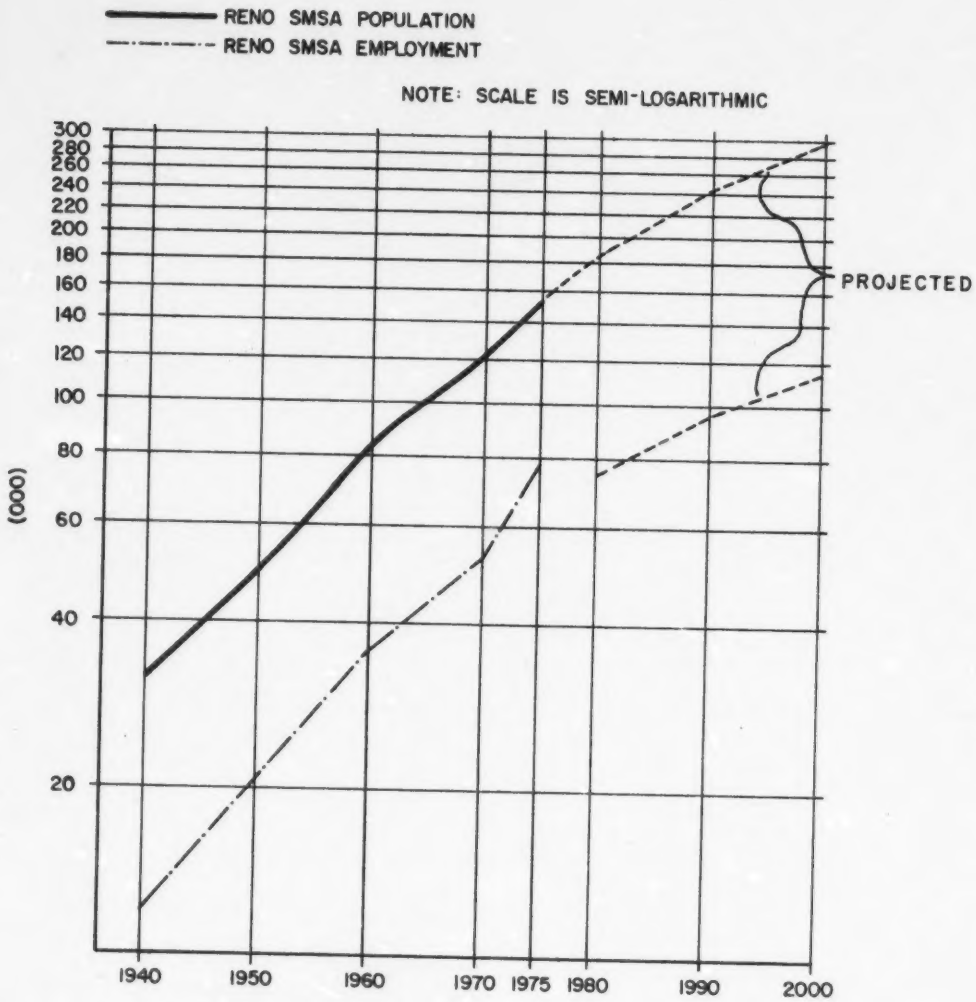
A = AGRICULTURE
MI = MINING
C = CONSTRUCTION
MA = MANUFACTURING

TCPU = TRANSPORTATION, COMMUNICATION, PUBLIC UTILITIES
T = TRADE
S = SERVICE
F = FINANCE, REAL ESTATE, INSURANCE
G = GOVERNMENT & NOT REPORTED

FIGURE 4-15 WASHOE CO. EMPLOYMENT DISTRIBUTION (SOURCE: TABLE 4-N)

FORECASTED WASHOE COUNTY EMPLOYMENT DISTRIBUTION

Figure 4-14



POPULATION AND EMPLOYEES, WASHOE COUNTY

Figure 4-15

PART III

PROJECT ALTERNATIVES, IMPACTS, MITIGATING MEASURES AND RESIDUAL IMPACTS

CHAPTER V	PROJECT ALTERNATIVES
CHAPTER VI	IMPACTS OF THE PROPOSED ACTIONS
CHAPTER VII	MITIGATING MEASURES AND PROBABLE UNAVOIDABLE ADVERSE IMPACTS
CHAPTER VIII	LOCAL SHORT TERM USES AND LONG TERM PRODUCTIVITY
CHAPTER IX	IRREVERSIBLE, IRRETRIEVABLE COMMITMENT OF RESOURCES

The third section describes the project alternatives and an initial screening process which sifts out the infeasible design alternatives. The remaining alternatives are subjected to an assessment of the environmental impacts they will create; a final screening is conducted and a preliminary choice is made of the final project alternative after consideration of all environmental effects. Mitigating measures are discussed which can alleviate detrimental impacts. A summary is given of the residual impacts. This section concludes with a discussion of the long term perspective on irretrievable commitment of resources for the selected project.

CHAPTER V

PROJECT ALTERNATIVES

INTRODUCTION

Wastewater Treatment

The existing Reno-Sparks JWPCP is currently operating close to design capacity. If the present population continues to grow at rates projected by the WCOG Areawide Water Quality Management Plan (W-1), the plant will become overloaded in 1978 and less efficient in waste removal. By 1983, phosphorus removal will be mandatory under requirements of the Federal Water Pollution Control Act (FWPCA), and additional treatment technology will have to be provided to comply with these requirements.

In response to pollution control mandates at the federal and state levels as well as local need for capacity expansion dictated by projected population growth, Kennedy Engineers, Inc. was retained to prepare a 201 Facilities Plan (K-1). This plan presented eight plant expansion alternatives and eight phosphorus removal/sludge disposal alternatives. The alternatives were developed to accommodate wastewater flows of 40 MGD, based on a design population of 267,000 for the year 2000 which was developed from projections of the WCOG Areawide Water Quality Management Plan, the Bureau of Business and Economic Research, the University of Nevada, and the State Division of Water Resources. A 10 percent adjustment upward was made due to increased wastewater flows during summer when tourism increases, resulting in an equivalent population figure of 296,000 which is to be accommodated by the expanded JWPCP. A detailed discussion of these population projections is presented in Chapter 4.

The expansion alternatives are based on a regional concept which will provide wastewater treatment for the service area and provide a variety of choices for treatment within the regional framework. In conjunction with the proposed expansion and upgrading, local sub-projects could be implemented to reduce waste volumes and water use. Such sub-projects might include local recycling programs, elimination of under-sink garbage grinders, changing from water-intensive land use (e.g., golf courses requiring irrigation), and development

of public information programs to alter attitudes toward water use. The cities have completed an infiltration/inflow study which revealed no evidence of significant infiltration into the existing wastewater collection systems. However, portions of the older sections of the community are served by combined sewers. Since 1967, stormwater inflow has decreased. This decrease is partly due to ongoing programs of the Cities of Reno and Sparks to separate storm and sanitary flows.

Interceptor Sewer Projects

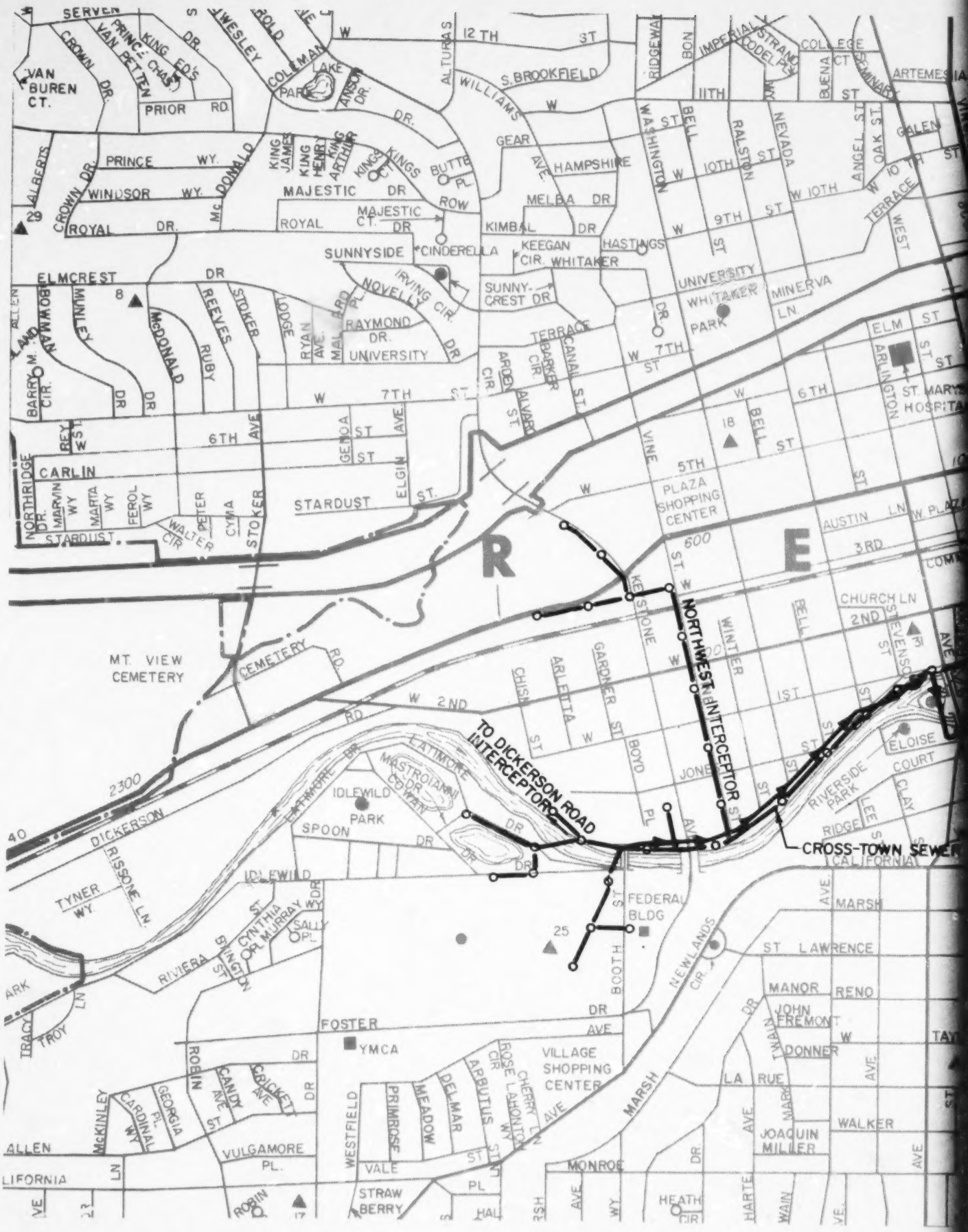
The Reno Cross-Town Sewer Study (T-2), prepared by Truckee Meadows Engineers in 1974, reports that the section of the North Truckee Meadows Interceptor (Figure 3-17) downstream of the old Reno sewer plant is currently carrying peak dry weather flows equal to the capacity of the line without surcharging the manholes.

Sewer master planning for the city has called for an extension of the Mill Street Interceptor Sewer to Riverside Drive and Booth Street (Figure 5-1) to connect with the Dickerson Road Interceptor Sewer. With this extension and diversion of upstream flows (Areas 2, 3, 7, Figure 3-17) to this new line, the existing First Street Sewer Line east of Arlington Avenue and the currently overloaded sections of the North Truckee Meadows Interceptor will have adequate capacity for development of their tributary area.

Planning for the Mill Street Interceptor size and alignment was completed in 1968 and the lower sections of this line--from Kirman Street to its connection with the South Truckee Meadows Interceptor--have been installed in conformance with the master plan.

The Dickerson Road Interceptor, also known as the First Phase of the Lawton Interceptor, was designed in 1966 to eventually extend to Verdi. The line was constructed to accommodate the ultimate population of that service area as set forth in the design report (T-14).

SEA Engineers was retained to prepare a 201 Facilities Plan (S-1) for the uncompleted section of the Mill Street Interceptor to Riverside Drive and Booth Street as well as for the balance of the Lawton Interceptor to Verdi. SEA refers to this entire program as the "Reno Cross-Town Interceptor".


NORTHWEST INTERCEPTOR
TO DICKERSON ROAD INTERCEPTOR
CROSS-TOWN SEWER
MT. VIEW CEMETERY
PLAZA SHOPPING CENTER
VILLAGE SHOPPING CENTER
FEDERAL BLDG
YMCA
IDLEWILD PARK
RIVERSIDE PARK
ST. MARY'S HOSPITAL
UNIVERSITY WHITAKER PARK
MAJESTIC DR
ELMCREST DR
CARLIN
STARDUST
DICKERSON
FOSTER AVE
MARSH
ST LAWRENCE
MONROE
VULGAMORE PL.
CALIFORNIA
12TH ST
11TH
10TH ST
9TH ST
7TH ST
6TH
5TH
3RD
2ND
1ST
W 2ND RD
CEMETERY RD.
WILLIAMS
S. BROOKFIELD
HAMPSHIRE
MELBA DR
KIMBAL DR
SUNNYSIDE
CINDERELLA
KEEGAN CIR.
WHITAKER
SUNNY-CREST DR
RAYMOND DR.
UNIVERSITY
TERRACE
CANAL ST.
ALVARD ST
ARDEN CIR
PARKER CIR
GENOA ST
ELGIN AVE
STOKER
RUBY
REEVES
LODGE
RYAN AVE
McDONALD
McKINLEY
VAN BUREN CT.
PRIOR RD.
PRINCE WY.
WINDSOR WY.
ROYAL DR.
CROWN DR.
ALBERTS
KING JAMES
KING HENRY
KING ARTHUR
KINGS CT.
BUTTE PL
ROW
COLEMAN
WESLEY
ALTURAS
ANSON DR.
LAKE PARK
PRINCE CHAS
KING ED'S
VAN BETTEN
SERVEN
WASHINGTON
BELL
RALSTON
NEVADA
ANGEL ST.
OAK ST.
GALEN
TERRACE
WEST
MINERVA LN.
ELM ST
ARLINGTON
VINE
WINTER
KEYSTONE
GARDNER ST
ARLETTA
CHISH ST
BOYD
JONES
AUSTIN LN
CHURCH LN
STEVENSON ST
ELOISE COURT
CLAY
LEE
RIDGE
BOOTH
NEWLANDS CIR.
MANOR
RENO
JOHN FREMONT
DONNER
LA RUE
WALKER
JOAQUIN MILLER
HEATH CIR
HARTE
WAIN
MARSH
TYNER WY.
RISSOME LN.
RIVIERA
CYNTHIA
MURRAY
SALLY PL
TROY LN
IRACY
ALLEN
GEORGIA
CARDINAL PL.
CANDY AVE
CRICKET AVE
ROBIN
WESTFIELD
PRIMROSE
MEADOW
DELMAR
ARBUTUS
ROSE LAHONTAN
CHERRY LN
STRAWBERRY
VALE
BARRY M. CIR.
NORTHRIDGE DR.
MARVIN WY
MARTA WY
FEROL WY
WALTER CIR
PETER
CYMA
ELOISE
IDLEWILD
SPOON DR
BALTIMORE DR
MASTROIANNI DR
2300
40
29
8
18
25
31
600
200

PROPOSED MILL ST INTERCEPTOR EXTENSION
CROSS-TOWN SEWER

FIGURE 5-1

2000
SCALE

This report will refer to this facility as two separate projects with two individual names: the "Lawton-Verdi Interceptor Sewer" and the "Cross-Town Sewer".

The Lawton-Verdi Interceptor Sewer will generally follow the gradient of the Truckee River and adjacent topography from Verdi through Lawton to a point of connection to the Reno sewerage system at Dickerson Road. Pipe size along its 10 mile course will vary from 18 to 36 inches. Typical pipe slopes will range from 0.80 percent in reaches upstream of Lawton to 0.30 percent downstream of Lawton. The Cross-Town Sewer will lie in existing streets through the residential and commercial districts of downtown Reno. Construction will be in close proximity to existing gas, electric, water and sewer lines. Alignments will require river crossings, water control, sheet piling, landscape replacement, and extensive pavement repair. Pipe will be 42 inch diameter reinforced concrete pipe with slopes and depths dictated by both existing underground conditions and connection requirements.

DESCRIPTION OF ALTERNATIVES

The Lawton-Verdi Interceptor Sewer (Numbered Alternates)

Alternate 1 - River Route: Calls for construction of the interceptor parallel and adjacent to the Truckee River. It will entail nine river crossings, water tight manholes, extensive revegetation, and two railroad crossings. Interceptor flows and flows from tributary areas will not require pumping facilities.

Alternate 2 - Railroad Route: Calls for construction of the interceptor adjacent to the Southern Pacific Railroad tracks. This alignment is generally at higher elevations than Alternate 1 and will require sewage lift stations to pump sewage to the interceptor from some tributary areas. This alternate does not require river crossings, but it does necessitate railroad jacking, tunneling, and 3900 linear feet of trestle to span cross canyons.

Alternate 3 - Follows the same course as the river alternate between Lawton and Dickerson Road and then follows the railroad alignment west to Verdi. It requires fewer river crossings than Alternate 1, but in addition it requires railroad jacking, tunneling, trestle construction and sewage lift stations.

Preceding page blank

The Cross-Town Sewer (Lettered Alternates)

Alternate A: This Cross-Town Alternate will be installed in Mill Street, westerly from Kirman Street, north in Virginia Street, west in Island Drive, north in Arlington, and southwest in Riverside Drive to Booth. This alignment requires two river crossings, approximately 2 miles of pavement repair and other items particular to placement of underground utilities.

Alternate B: This alignment is the same as Alternate A to Riverside Drive and Jones Street where it turns west in Jones Street. Two river branch crossings are required plus other items particular to placement of underground utilities.

Alternate C: This alternate follows the same alignment as Alternates A and B to Arlington Avenue. At Arlington the alignment crosses the southern edge of Wingfield Park, crosses the river to Jones and Riverside Drive and proceeds southwest in Riverside Drive to Booth. One river crossing is required and a portion of line would be installed on streets which carry limited traffic.

Alternate D: Follows the same alignment as alternate C to Riverside Drive and Jones Street, it then continues westerly down Jones to a point of connection. One river crossing is required and a portion of this line would be installed on streets with limited traffic use.

Alternate E: This alternate follows an alignment on Mill Street to Holcomb Street where it turns north to the river. The alignment would be in the river channel to Wingfield Park, northwest across the park near Arlington, and then southwest in Riverside Drive to Booth. This alignment would require extensive sheet piling along the river channel, two river crossings, cutting retaining walls, and extensive revegetation.

Alternate F: This alternate will follow the same alignment as Alternate E to Jones Street and Riverside Drive, then west in Jones Street to a point of connection. Again extensive sheet piling, cutting retaining walls, two river crossings, and extensive revegetation are required.

Sewage Treatment Plant Expansion Alternatives

In order to treat the flows generated by projected future population in the service area, the current facilities must be expanded. In addition, the facilities must be capable of reducing phosphorus levels in the plant effluent to meet 1983 requirements of the FWPCA. This will entail additional equipment exceeding that already existing or proposed for expansion of hydraulic capacity.

Moreover, in a letter from the State of Nevada, Department of Human Resources (dated March 28, 1975), the City of Reno was informed that ammonia removal may be required at a later date. The exact provisions required to achieve these standards are not discernible at present, since standards for ammonia have not yet been defined. Both ammonia removal and phosphorus removal are described below.

- Phosphorus Removal

  Chemical precipitation is a recognized technique for phosphorous removal (K-1). Phosphorous removal has been considered in the 201 Facilities Plan (K-1) and will not be discussed further until detailed descriptions of alternatives are presented. The "PhoStrip" process for phosphorus removal, however, does warrant discussion. The process itself is relatively new but has been proven effective in pilot scale studies conducted at the Reno-Sparks JWPCP (K-1). These studies are documented in detail in the 201 Facilities Plan, but for purposes of this report, a brief description is provided. As its process influent, the PhoStrip process takes all or a portion of the return activated sludge mass from the process stream and uses a stripping tank to induce controlled phosphorous release under anaerobic conditions. Under these conditions, phosphorus is released into the supernatant. The levels are in the range of 50 to 60 mg/l of $P\text{-}PO_4$ which is approximately 10 times the levels in the influent raw sewage. The net result is a concentration of phosphorus in a side stream. Consequently, this side stream (being of smaller volume) will be easier to treat with lime for removal of the phosphorus.

- Ammonia Removal

Although a number of ammonia removal processes are available, one such process is particularly feasible due to the abundance of waste activated sludge inherently produced at the plant. This process is known as nitrification.

Nitrification is conducted in facilities similar to those required for the aeration stage of the secondary treatment process. However, nitrification requires lower organic levels in the process influent, some alkalinity (as CO_3-2) and a lesser sludge wasting rate. The effluent from the process is considered to be nitrified, and most of the ammonia will have been converted to nitrate. The levels of this nitrate are anticipated to be in the range of 20 mg/l of NO_3-N.

- Hydraulic/Present Degree of Treatment Expansion (Numbered Alternatives)

In compiling alternatives for evaluation in the Reno-Sparks 201 Facilities Plan, Kennedy Engineers, Inc. (K-1) considered proposals which would simply expand the facilities of the existing plant to obtain the degree of treatment currently attained but with greater hydraulic capacity. Eight possible alternatives were discussed for plant expansion and are presented as follows:

Alternative 1: Expand the facility and operate according to present methods.

Alternative 2: Expand and operate the facility as operated at present, with the exception of changing air bubble diffusers to a liner nozzle.

Alternative 3: Expand and operate the facility as operated at present, with the exception of changing the air diffuser system to the Penberthy system.

Alternative 4: Expand the facility and operate with high concentration of micro-organisms in the aeration chambers.

Alternative 5: Change air diffuser heads in the existing facilities and use the Biodisc technique to handle any flows in excess of 20 MGD (which pass through the aeration system).

Alternative 6*: Utilize existing facilities but with major modifications to incorporate use of the "Oasis" pure oxygen system.

Alternative 7*: Utilize existing facilities but with major modifications to incorporate the use of the "Unox" process.

Alternative 8: Expand the facility and incorporate the "Zimpro" process, which entails the addition of powdered activated carbon to the influent of the secondary process.

In summary, the alternatives were derived with the assumption that the existing facilities would be maintained. This dictates the range of alternatives available for plant expansion.

The mode of operation used is the activated sludge process. This process is widely utilized and has a reputation for being reliable. However, it is subject to upset by variations in process influent. The aeration equipment utilizes a large amount of electricity which will raise operation and maintenance costs, especially as energy costs continue to rise significantly.

Processes involving chemical precipitation are more easily controlled but are more expensive than biological systems, due to the chemicals required. Moreover, chemical additions are noted for their large sludge production and increased sludge handling costs.

In terms of reliability, physical-chemical methods are less affected by uncontrollable parameters, such as sludge discharges from industry, than are biological methods. Reno-Sparks has much less industry than is

---

*These alternatives will require placing covers on the aeration tanks and modifying all appropriate equipment to facilitate the use of pure oxygen as an oxygen source, instead of the more conventional practice of using air.

normal for a town of the same size and influent quality would not be expected to vary a great deal. However, the 201 Facilities Plan cites a case of a small plating facility with a spill of chromic acid. This episode mildly affected plant operations for a few days (K-1).

- Overflows, Bypasses, and Storage

Occurrences of bypassing in the existing system are extremely rare. There are no known bypassing structures in the collection system with the exception of the controlled overflow at the sewage treatment plant. The influent pumps at the plant have dual feeder systems which minimize the chances of the system being incapacitated for any significant length of time. The interceptor lines are available for storage and the existing system has an estimated maximum flow storage capacity of one-half day in major lines leading to the plant. At 40 MGD this capacity will be reduced to approximately one-quarter day. This projected storage capacity is not unusual for successful sewerage and wastewater treatment systems similar to the Reno-Sparks system and should be adequate for such a system.

- Sludge Handling/Disposal Alternatives (Lettered Alternatives)

In order to improve the sludge handling methods, to remove the sludge drying beds from the floodplain, and to introduce phosphorus removal to the reaction train, the 201 Facilities Plan presented a total of eight alternatives.

Several of these alternatives entail the construction of a pipeline system to Spanish Springs Valley. This system will be utilized to convey liquid digested sludge and phosphorus-rich supernatant from the PhoStrip process (or a mixture of the latter and plant effluent.) Thus, this pipeline system is considered a sound method for continuously transporting digested sludge and water to the proposed irrigation site.

The alternatives for handling sludge and removing phosphorus are summarized below:

Alternate A: Alum addition to the aeration tanks to remove phosphorus and anaerobic digestion and mechanical dewatering of the sludge. Ultimate sludge disposal will then be accomplished by truck to a landfill site.

Alternative B: Lime addition to primary settling facilities, with supplemental alum additions to the aeration tanks. This will achieve the desired phosphorus removal levels. The sludge will then be mechanically dewatered and incinerated, followed by land disposal of ash.

Alternative C: PhoStrip operation for phosphorus removal, with lime precipitation of the phosphorus. All sludges will be anaerobically digested, mechanically dewatered and transported to a landfill.

Alternative D: PhoStrip operation for phosphorus removal, with the phosphorus-rich supernatant being used to irrigate an area in Spanish Springs Valley.* The sludge will be anaerobically digested and the liquid digested sludge pumped to Spanish Springs Valley for irrigation.

Alternative E: Alum addition to aeration tanks during winter, with discharge of plant effluent to Orr Ditch for irrigation during the summer.** Sludge to be anaerobically digested, mechanically dewatered and landfilled.

The next three alternatives are all variations of Alternative D. They differ primarily in schedule and seasonal operation.

Alternative F: PhoStrip operation on year-round basis with the supernatant irrigated in the summer and subsurface leached in the winter. Anaerobically digested sludge will be irrigated at Spanish Springs during the summer, and stored there during the winter.

Alternative G: PhoStrip operation on year-round basis, with supernatant irrigation during the summer and lime treatment during the winter. Anaerobically digested sludge will be irrigated during the summer and stored at Spanish Springs during the winter.

---

*Initially, another land disposal site was also considered.

**During the summer, the plant effluent would replace some irrigation waters taken from Truckee River.

Alternative H: PhoStrip operation and lime treatment of supernatant, with the exception that during summer a portion of the supernatant is used for irrigation at Spanish Springs. Anaerobically digested sludge will be irrigated during summer and stored at Spanish Springs during winter.

- Land Treatment of Sludge and Secondary Wastewater

The use of municipal wastes as soil conditioners and irrigation waters has been practiced for centuries. In this practice, the waste (sludge and secondary wastewater) from wastewater treatment plants is applied to the land, providing nutrients and moisture to the soil and thereby sustaining agricultural activity. The rates of application, seasonal loadings, and ultimate efficiency of this system depends primarily on soils at the site, local climate, groundwater patterns, quality of the waste, and crops grown on the site. Many successful land treatment programs are operating in arid and semi-arid environments. If a land treatment system is designed and operated properly, the municipal wastes can be utilized as a valuable and productive resource, eliminating a portion of treatment necessary in conventional wastewater treatment facilities.

There are a variety of application methods which can be employed in land treatment systems. Basically, wastewater is applied to an area with or without waste sludge, depending upon the desired system. The land is usually planted with a harvestable crop and managed similarly to any agricultural area. Sludge can be applied in the irrigation waters, applied separately in a more or less solid form, or disposed of in another manner such as landfilling. Land application is limited to the growing season in temperate climates and wastewater and sludge are usually stored during winter in holding lagoons.

CONSTRAINTS ON CONSIDERATION OF ALTERNATIVES

In the development and ultimate selection of alternatives, certain constraints must be considered that suggest the most practical approaches to the wastewater treatment process and the least damaging approach to pipeline installation. Some of these constraints are legal in nature and others are specific to the environment such as topography, urban patterns, and background water quality. A brief outline of constraints

which act on the consideration of alternatives for treatment plant and sewer routes in the Reno-Sparks service area is provided in the following section.

Wastewater Treatment

The following controls, limits and statutes are of particular importance in evaluating the range of alternatives considered for the JWPCP expansion.

- Water Quality Standards

  The FWPCA Amendments of 1972 established as a national policy, the attainment of water quailty "which provides for the protection and propagation of fish, shellfish and wildlife...". The water quality standards promulgated as a result of this legislation by responsible federal and state agencies must be considered in the design of treatment systems. Each design alternative (expansion and effluent disposal option) considered in the 201 Facilities Plan (K-1) will meet existing and future requirements.

- Use of Floodplain

  The Washoe County District Public Health Department has restricted the use of floodplain lands for sludge drying beds with a regulation which will eliminate that alternative by 1978. This regulation, in addition to Section 201 of the FWPCA, which encourages the investigation of reuse of sewage pollutants, had led to the consideration of land treatment outside the floodplain as a sludge disposal alternative.

- Water Availability

  From a regional standpoint, the major consideration in developing and evaluating wastewater treatment alternatives for the Reno-Sparks area is the importance and limitations of the water resource. In an arid region such as Nevada, water is an important commodity. With the present regulations for flow released into the Truckee River, the pending legal decision concerning the Paiute Indians' rights to water for Pyramid Lake, and the present growth/water usage rates continuing, a water availability crisis seems inevitable. Although the legal and hydrologic aspects of the area's water budget are discussed in detail in Chapter 3, several features should be mentioned again.

The water rights and total water supply issues are of over-riding importance both because of the current court action brought by the Paiute Tribe against the current water rights holders in the basin and the seasonal supply/demand water budget implications. Therefore, any diminution of the water resource as a consequence of wastewater treatment can affect critical downstream flows and is of major importance in considering alternatives.

In response to this issue, the project alternatives for plant expansion and disposal have been arranged into concepts, as described later in this chapter, in order to effectively analyze a wider variety of proposed alternates for the expansion in conjunction with compatible disposal alternatives which are sensitive to water availability.

- Service Area Requirements

An additional constraint which controls the development of project alternatives is the projected capacity of the plant which will be required for the service area. Before alternatives for a wastewater treatment plant can be designed, anticipated population levels and growth rates for the projected service period (1980 to 2000) must be determined. The 201 Facilities Plan (K-1) reviewed population projections as outlined in the introduction of this chapter for the service area and systematically selected a design capacity of 40 MGD from these estimates. It is conceivable that the projections used in this evaluation will be proven incorrect and either be significantly lower or higher. At this time, however, the design capacity reflects the best estimate of population growth within the service areas as an average of projections by responsible government and agencies. The alternatives developed in the 201 Plan are based upon satisfying the projected need for treatment, both in terms of capacity, water quality regulations, and water use within the Lower Truckee River Basin.

The use of wastewater for irrigation outside of the floodplain, and in any area where no return flow would occur, would eliminate the need for phosphorus removal (K-1). However, the use of the entire effluent as irrigation water would be considerably more costly

when one considers both the installed cost of an irrigation system plus the annual energy cost to pump and convey the entire wastewater flows, rather than the proposed tertiary treatment program.

- Cost-effectiveness of Incremental Expansion of the Pollution Control Plant

Cost-effective comparisons have been completed for various alternative increments of a phased expansion program. Capacities of existing modules limit the increments of expansion to 10, 13-1/3 and 20 MGD. The Reno-Sparks JWPCP consists of three separate modules which are contiguous with common tank walls in a single rectangular structure. Each module consists of a primary sedimentation tank, an aeration tank, and a secondary sedimentation tank with equipment and controls required to operate each module separately. Each module discharges into the post aeration tank. Each parallel group of tanks was originally designed to have a capacity of 6-2/3 MGD under the 20 MGD plant design concept.

The BOD of the primary effluent has been observed to be less than originally predicted. The three existing aeration tanks are capable of treating more than their rated capacity. A plant scale operational test confirmed that one existing aeration tank could treat 10 MGD without degrading the secondary effluent. Each of the sedimentation tanks is still considered to have a rated capacity of 6-2/3 MGD.

Three plans for phased construction have been prepared by Kennedy Engineers for the program recommended in the Facility Plan (Alternate 3H). A tabular summary of the three plans is presented in Table 5-A.

The cost-effectiveness of the phased expansion alternatives appears essentially equal to the single increment plan based on 1975 dollars, within the range of estimating accuracy. When one considers the recent rapid rate of ascent of the treatment plant construction cost index in comparison with the general inflation rate, there is a clear advantage in the single increment program.

With current peak flow rates approaching 24 MGD and with an existing unsewered population which could contribute 3 MGD when trunk sewer extensions are installed, the

TABLE 5-A

INCREMENTAL PLANT EXPANSION

	Plan 3H	Plan 3H 1	Plan 3H 2
Initial increment of expansion (MGD)	20	10	13.5
Second increment of expansion (MGD)	--	10	6.5
1980 flow expressed as percent of design capacity	60	80	72
Capital costs[a]			
Initial increment	$23,011,000	$19,701,000	$20,643,000
Second increment	--	4,503,000	3,123,000
Total	$23,011,000	$24,204,000	$23,766,000

NOTES: [a] June 1975 dollars

practicality of the 10 MGD or even a 13-1/3 MGD increment seems marginal. As Kennedy Engineers indicates, planning for the second increment of expansion of the 30 MGD plant would begin immediately upon completion of the first 10 MGD increment. Any savings which could be effected by improved future design practices or construction techniques would be more than offset by the additional administrative and contingency costs of a multi-phased project.

- Sewerage Projects

Constraints on selection of sewerage route alternates can be divided into two categories. Topographic and geologic constraints act primarily on the Lawton-Verdi Interceptor, while traffic, business disruption, noise, and underground utility factors are of primary importance to the Cross-Town Sewer.

Routings of the Lawton-Verdi Interceptor will be in the lower regions of the canyon, and will be subject to sudden changes in elevations and alignment. In areas where the canyon narrows and only limited rights-of-way are available, tressel type pipe structures will be necessary. Water-tight manholes and pipe must be installed in proximity to the river, and river crossings for sewer connections from adjacent areas will be necessary.

The railroad route, while maintaining higher elevations west of Lawton, will be subject to rough canyon terrain. Sewage lift stations must be strategically located in the lower basin to pump up to the higher interceptor line. Railroad jacking will be needed at some locations, as will tressels, pipe hangers, and other types of complex and difficult construction techniques.

Area soils generally consist of outwash gravels comprised of cobbles and boulders; trenching may therefore entail extensive shoring, laying back of slopes at 1:1 and continuous control of trench waters. Natural slopes will be disturbed, new slopes will be created, V-ditches, berms, and rip-rap must be placed to retard erosion.

Since the Cross-Town Sewer traverses an urban area, the constraining factors are essentially those of disturbance to existing development and inconvenience

during construction. These factors affect all alternatives and the tradeoff for selection is primarily that of minimizing disruptive consequences in route selection.

The physical constraints which apply to the sewerage projects and their routings are primarily those which affect the cost of construction. Consequently, cost, in itself, is a major limiting factor in the consideration of alternatives.

Due to the condemnation powers of the City of Reno, availability of rights-of-way is not considered to be a constraint and the archaeological reconnaissance did not reveal evidence of any significant prehistoric habitats which limited the route alternatives under consideration.

The service area requirements provide an additional constraint on the sewerage alternatives. Projected population levels and growth rates for the areas tributary to the sewer lines must be determined for the projected service period (to year 2000). The line sizes should be selected to provide for this period or any more cost-effective alternate program should be identified for consideration.

SCREENING OF ALTERNATIVES

Because of the significant number of alternatives presented, initial screening and grouping of the options available is a necessary first step. This screening process is intended to remove from active consideration alternatives which are clearly infeasible.

A grouping of alternatives also leads to a more meaningful final analysis by allowing first consideration of wastewater treatment concepts prior to consideration of process details.

The Lawton-Verdi Interceptor Routes

Initial screening of alternate routes to arrive at two alignments plus a no project alternative is aided by a simultaneous and comparative look at the array of factors which constitute the adverse consequences of construction. Each alternative is assigned a high, low, or average rating as to the adverse effects of the particular factor which has been isolated as broadly significant for initial screening. In addition, each

factor is identified as to its relative importance as viewed by the assessment team in respect to the trade-off decision among alternatives. Table 5-B presents the initial screening matrix for the Lawton-Verdi routes.

Study of the matrix reveals high contrast between Route Alternates 1 and 2. Both the river route (Alternate 1) and the railroad route (Alternate 2) have significant construction problems to overcome as well as different areas of environmental impact requiring mitigating measures. The compromise (Alternate 3) which follows the river route to Lawton and the railroad route beyond to Verdi can be viewed as a design option for either of the basic routes.

Since they offer clearly different cost, environmental and construction consequences, Alternates 1 and 2 are carried forward for more detailed assessment in Chapter 6 of this study.

The Cross-Town Sewer Routes

Although differing parameters reflecting urban as well as riverine impacts apply to the Cross-Town Sewer routes, they can be initially screened with the same matrix approach described above. Table 5-C sets forth the results.

Cursory examination of Table 5-C reveals the similarity of Alternates A and B with very comparable costs and allows their grouping for further comparison. Likewise, Alternates C and D tend to offer a distinctive package characterized by lower environmental impact but higher costs. Alternates E and F are also remarkably similar in their consequences and are significantly higher in price. Maximum river disturbance is seen for Alternates E and F as well which argues for their elimination* from future consideration.

In effect, then, it appears appropriate to reduce the six Cross-Town routes to two: Alternate AB and Alternate CD. Minor routing options on Jones Street or Riverside Drive are applicable to both alternates.

---

*Studies are currently being conducted to alter and extend the channelization of the Truckee River in the downtown area. Should this plan be adopted and implemented prior to or in combination with the installation of this sewer main, impacts on the river from the sewer construction would be reduced and Alternatives E and F may warrant reconsideration.

TABLE 5-B

INITIAL SCREENING MATRIX
THE LAWTON-VERDI INTERCEPTOR SEWER ROUTES[a]

	Relative Importance	Alternates[b] 1	2	3
River Disturbance	maximum	high	low	ave
Re-Vegetation	maximum	high	low	ave
Sewage Lift Station	moderate	low	high	ave
Trestle Construction	maximum	low	high	ave
Tunnels	minimum	low	ave	ave
Railroad Jacking	minimum	low	high	ave
Highway Traffic Control	minimum	ave	ave	ave
Operational Cost (20-year)	moderate	ave	ave	ave
Ditch Crossings	moderate	low	high	ave
Hazardous Construction	maximum	low	high	ave
Maintenance Access	moderate	high	low	ave

PROJECT COST

	Capital Cost	20-Yr. Annual Cost	40-Yr. Annual Cost
Alternate 1	$9,496,000	$926,000/yr.	$742,000/yr.
Alternate 2	$8,918,000	$921,750/yr.	$964,000/yr
Alternate 3	$9,297,000	$940,000/yr.	$860,000/yr.

NOTES: (a) This matrix prepared for initial screening to determine the two most suitable alternates only.

(b) high = high adverse effects
ave = average adverse effects
low = low adverse effects

TABLE 5-C

INITIAL SCREENING MATRIX
THE CROSS-TOWN SEWER ROUTES[a]

	Relative Importance	Alternates[b] A	B	C	D	E	F
River Disturbance	maximum	ave	ave	low	low	high	high
Landscape Displacement	maximum	ave	ave	low	low	high	high
Noise Impacts	moderate	low	low	low	low	ave	ave
Traffic Impacts	maximum	ave	ave	low	low	low	low
Interference with Commercial Act.	maximum	ave	ave	ave	ave	low	low
Energy Consumption	minimum	ave	ave	ave	ave	low	low
Cost	moderate	ave	ave	ave	ave	high	high
Underground Obstructions	minimum	ave	ave	ave	ave	low	low
Property Access	moderate	ave	ave	ave	ave	low	low

PROJECT COST

	Capital Cost	40-Yr. Annual Cost
Alternate A	$1,657,000	$161,000
Alternate B	$1,736,000	$168,000
Alternate C	$1,968,000	$190,000
Alternate D	$1,776,000	$172,000
Alternate E	$3,213,000	$308,000
Alternate F	$3,295,000	$316,000

NOTES: (a) This matrix prepared for initial screening to determine the two most suitable alternates only.

(b) high - high adverse effects
ave - average adverse effects
low - low adverse effects

Wastewater Treatment/Sludge Handling Concepts

Eight plant expansion alternatives and eight sludge disposal options were initially presented in the 201 Facilities Plan (K-1). Infeasible alternatives cited and eliminated in the Facilities Plan are:

- Sludge disposal Alternative D which required the storage of PhoStrip supernatant and digested sludge through the winter season was eliminated because of high cost.

- Pumping the plant secondary effluent to Orr Ditch for irrigation use, Alternative E, was eliminated due to the adverse effect of water quality.

An analysis of the alternatives discarded by Kennedy Engineers for economic or engineering reasons showed that Alternative 4, the "Penberthy" (short detention-high solids) system, was not sufficiently tested to be included in a design at this time. However, the system may have received full scale experience when the final design is undertaken and should be reconsidered at that time. The environmental implications of exchanging this system for a similar one (e.g., Alternative 3) should a similar system be selected, are insignificant if the short detention-high solids system proves efficient.

Alternative D was discarded and F, G, and H further defined to provide adequate consideration of a land treatment system. F, G, and H differ from D in their reduced storage capacity of sludge and PhoStrip supernatant and thereby reduced expense. This screening process is a logical one which removed from consideration an expensive land treatment system which would store the sludge and supernatant over winter and replaced it with three more feasible systems which will be considered in the impacts section.

Further analysis of Alternative E revealed that the PhoStrip method is indeed less expensive than discharging secondary effluent into Orr Ditch as reported by Kennedy Engineers, and the probable reduction in water quality in Orr Ditch under Alternative E would likely be environmentally unacceptable in any case because it is currently a domestic water source for the Oasis Trailer Park. An environmental basis of eliminating Alternative E concurs with economic and engineering factors which also argue for its abandonment.

The net result of the alternatives eliminated is more complex than simply described above due to the interrelation of treatment process and sludge disposal means. Figure 5-2 graphically displays those alternative combinations and the reasons for their elimination.

Technical review of the remaining alternatives allowed their grouping in a conceptual matrix according to their basic components and environmental ramifications as discussed below.

Conceptual Matrix

Figure 5-3 graphically displayed a proposed conceptual matrix for this report. The chemical requirements, effluent parameters, and costs for each of the four concepts and the no-action alternatives are presented in Tables 5-D through 5-H. Within each concept, individual alternatives may differ in certain parameters and these differences are identified under "Minimum", "Intermediate", and "Maximum" columns with the contributing alternative identified in parentheses. The tables were developed, in part, from the 201 Facilities Plan, EPA figures for national averages when specific quantities were unavailable, and effluent data from the existing plant. All parameters are based upon a 40 MGD capacity.

- Concept I to include:

  Treatment Alternatives 1, 2, 3 and 5

  (All conventional activated sludge processes)

  Disposal Alternatives F, G and H

  (All utilizing irrigation disposal of secondary wastes)

- Concept II to include:

  Treatment Alternatives 1, 2, 3 and 5

  Disposal Alternatives A, B and C

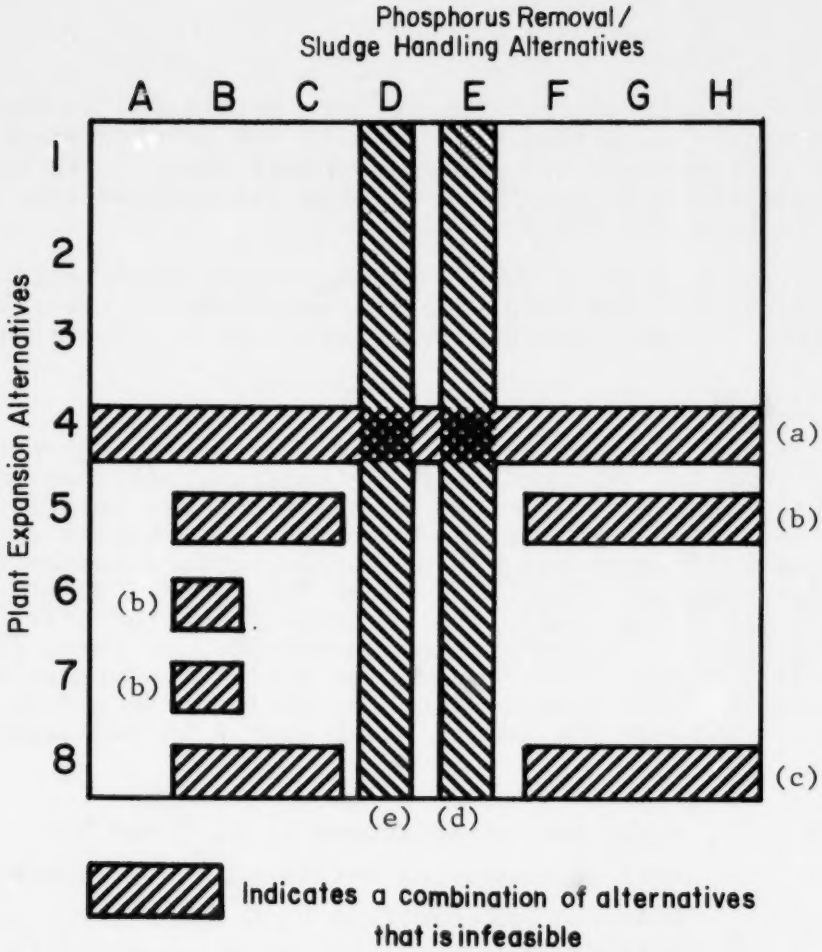
  (All utilizing chemical tertiary treatment and land disposal of sludge)

- Concept III to include:

  Treatment Alternatives 6, 7 and 8

  (All modified activated sludge processes)

  Disposal Alternatives F, G and H



(a) Infeasible due to untested technology

(b) Infeasible due to cost

(c) Infeasible due to cost

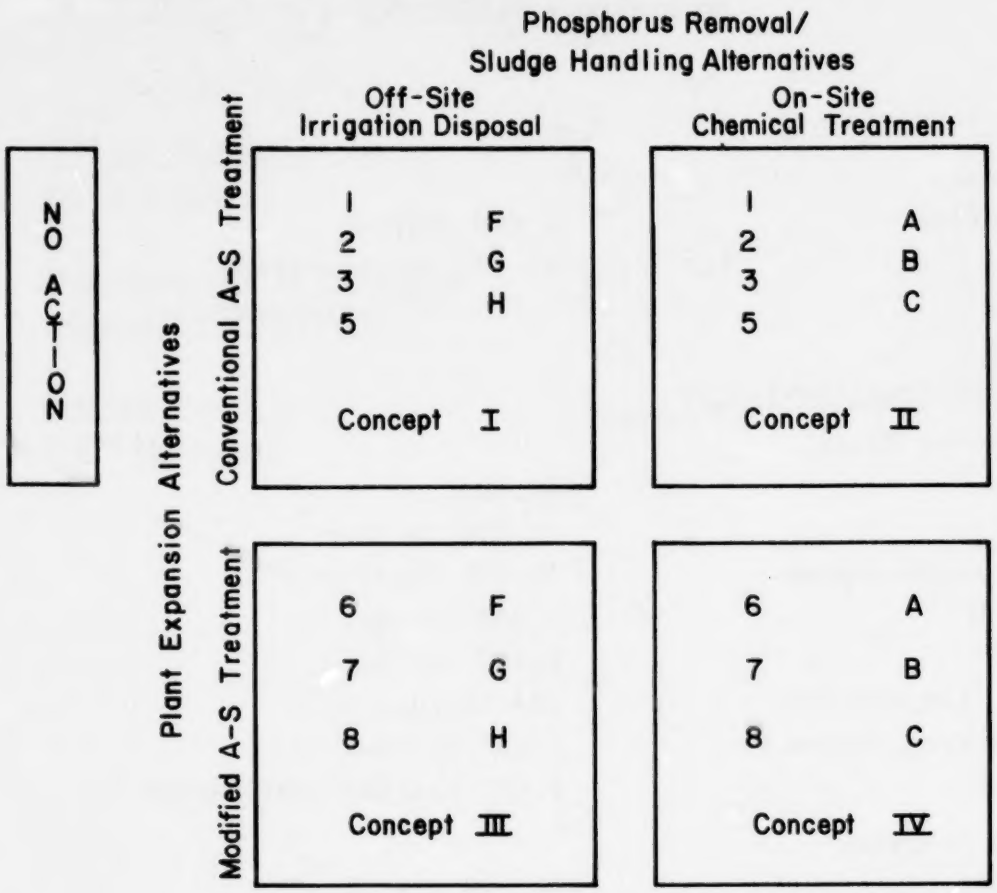
(d) Infeasible due to water quality

(e) Infeasible due to cost

ALTERNATIVES FORMULATED BY KENNEDY ENGINEERS, INC. FOR RENO/SPARKS 201 FACILITIES PLAN

Source: (K-1, R-31)

Figure 5-2



CONCEPTUAL MATRIX TREATMENT/SLUDGE
HANDLING ALTERNATIVES

Source: (K-1)

Figure 5-3

TABLE 5-Da

OPERATING REQUIREMENTS AND EFFLUENT PARAMETERS FOR THE NO ACTION ALTERNATIVE

Plant Requirements	
Chemicals	
Chlorine	1,600 lbs/day
Labor	45,920 manhours/year
Energy	9.7×10^6 kwhrs/year
Effluent Characteristics	
To Truckee River	
Flow	40 MGD
BOD_5	41,000 lbs/day
Suspended Solids	41,000 lbs/day
NO_3-N	1,000 lbs/day
PO_4-P	1,670 lbs/day
Chlorine Residual	367 lbs/day
Dissolved Oxygen	2,637 lbs/day
NH_3-N	6,670 lbs/day (estimated)
Sludge Disposal	
Solids (digested)	34,400 lbs/day
Phosphorus	534 lbs/day
Nitrogen	2,500 lbs/day
Water	0.16 MGD
Zinc	193 lbs/day
Copper	103 lbs/day
Nickel	12 lbs/day
Cadmium	10 lbs/day

TABLE 5-Db

OPERATING REQUIREMENTS AND EFFLUENT PARAMETERS FOR THE NO ACTION ALTERNATIVE
(continued)

Capital Expenditures (1975 dollars)	N/A
Operation and Maintenance (annual 1975 dollars)	628,400
Present Worth (1975 dollars)	6.66 million

Source: (R-30, E-20)

TABLE 5-Ea

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT I

	Minimum[a]	Intermediate[a]	Maximum[a]
Plant Requirements			
Chemicals			
Chlorine (lbs/day)	--	1,600	--
Lime (lbs/day)	None (F)	5,786 (G)	12,625 (H)
Ferric Chloride (lbs/day)	None (F)	None	None
Alum (lbs/day)	None (F)	None	None
Labor (manhours/year)	52,890 (3F)	57,890 (average)	61,190 (2G, 2H)
Energy (kwhrs/year)	11.75 x 10^6 kwhrs (3H)	17.82 x 10^6 kwhrs (average)	27.95 x 10^6 (1F, 1G)
Effluent Characteristics			
To Truckee River			
Flow (MGD)	34.6 (F)	36.8 (G)	39.3 (H)
BOD_5 (lbs/day)	--	2,670	--
Suspended Solids (lbs/day)	--	4,673	--
NO_3-N (lbs/day)	--	1,869	--
PO_4-P (lbs/day)	--	234	--
Chlorine Residual (lbs/day)	--	367	--
Dissolved Oxygen (lbs/day)	--	2,637	--

TABLE 5-Eb

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT I (continued)

	Minimum[a]	Intermediate[a]	Maximum[a]
To Land Disposal Site			
Sludge Solids (lbs/day)	34,000 (F)	38,600 (G)	43,300 (H)
Phosphorus (lbs/day)	--	2,036 (F,G,H)	--
Nitrogen (lbs/day)	1,833 (H)	2,479 (G)	3,022 (F)
Potassium (lbs/day)	0.5	0.5	0.5
Water (MGD)	0.7 (H)	3.21 (G)	5.35 (F)
Zinc (lbs/day)	193 (F)	216 (G)	242 (H)
Copper (lbs/day)	103 (F)	116 (G)	130 (H)
Nickel (lbs/day)	12 (F)	14 (G)	15 (H)
Cadmium (lbs/day)	10 (F)	11 (G)	12 (H)
Capital Costs (millions 1975 dollars)	22.53 (2H)	25.42 (average)	29.67 (1F)
Operation and Maintenance (thousands annual 1975 dollars)	813 (3F)	970 (average)	1,206 (1H)
Present Worth[b] (millions 1975 dollars)	32.76 (3G)	35.70 (average)	40.85 (1F)

TABLE 5-Ec

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS
FOR CONCEPT I
(continued)

NOTES: (a) ( ) Identifies alternative within the concept

(b) Calculated at 7 percent for 20 years (annual payments); present worth = 10.5940

Source: (E-20, K-1, E-21, E-22)

TABLE 5-Fa

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT II

	Minimum[a]	Intermediate[a]	Maximum[a]
Plant Requirements			
Chemicals			
Chlorine (lbs/day)	1,600	1,600	1,600
Lime (lbs/day)	5,512 (A)	19,030 (C)	66,850 (B)
Ferric Chloride (lbs/day)	1,775 (C)	--	1,836 (A)
Alum (lbs/day)	10,016 (B)	--	53,425 (A)
Labor (manhours/year)	55,110 (3B)	64,997 (average)	71,070 (2A)
Energy (kwhrs/year)	9.64×10^6 (3A)	63.03×10^6 (average)	168.6×10^6 (1B)
Effluent Characteristics			
To Truckee River			
Flow (MGD)	--	40	--
BOD_5 (lbs/day)	--	2,670	--
Suspended Solids (lbs/day)	--	4,673	--
NO_3-N (lbs/day)	--	1,869	--
PO_4-P (lbs/day)	234 (B,C)	--	335 (A)
Chlorine Residual (lbs/day)	--	367	--
Dissolved Oxygen (lbs/day)	--	2,637	--
Aluminum (lbs/day)	-- (C)	167 (B)	267 (A)
Calcium (lbs/day)	--(A,C)	--	13,352 (B)

TABLE 5-Fb

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT II (continued)

	Minimum (a)	Intermediate (a)	Maximum (a)
To Landfill Area			
Water (MGD)	-- (B)	0.01 (A)	0.20 (C)
Solids (lbs/day)	44,400 (C)	45,951 (A)	86,500 (B)
Nitrogen (lbs/day)	1,720 (C)	2,500 (A)	5,320 (B)
Phosphorus (lbs/day)	1,933 (A)	2,126 (C)	2,194 (B)
Calcium (lbs/day)	2,570 (A)	2,882 (C)	28,467 (B)
Iron (lbs/day)	--(B)	548 (A)	614 (C)
Potassium (lbs/day)	--	0.5 (A,B,C,)	--
Aluminum (lbs/day)	-- (C)	256 (B)	4,554 (A)
Zinc (lbs/day)	249 (C)	257 (A)	484 (B)
Copper (lbs/day)	133 (C)	138 (A)	260 (B)
Nickel (lbs/day)	16 (C)	16 (A)	30 (B)
Cadmium (lbs/day)	12 (C)	13 (A)	24 (B)
Incinerator Emissions			
Temp. (°F)	--	≮900°F (B)	--
Particulates (lbs/day)	--	201 (B)	--
Carbon Dioxide (lbs/day)	--	472,000 (B)	--
Sulfur Dioxide (lbs/day)	--	34 (B)	--
Nitrogen Oxides (lbs/day)	--	450 (B)	--
Air Required (lbs/day)	--	4.83×10^6 (B)	--
Natural Gas (cf/day)	--	134,000 (B)	--

TABLE 5-Fc

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT II (continued)

	Minimum[a]	Intermediate[a]	Maximum[a]
Capital Costs (millions 1975 dollars)	14.12 (2C)	16.75 (average)	21.51 (B)
Operation and Maintenance (thousands 1975 dollars)	1,066 (3C)	1,366 (average)	1,723 (1A)
Present Worth[b] (millions 1975 dollars)	25.89 (3C)	31.23 (average)	37.72 (1B)

NOTES: (a) ( ) Identifies alternative within the concept

(b) Calculated at 7 percent for 20 years (annual payments); present worth = 10.5940

Source: (E-20, K-1, E-21, E-22)

TABLE 5-Ga

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT III

	Minimum [a]	Intermediate [a]	Maximum [a]
Plant Requirements			
Chemicals			
Chlorine (lbs/day)	--	1,600	--
Lime (lbs/day)	5,786 (6G,7G,8G)	--	12,625 (6H,7H, 8H)
Ferric Chloride (lbs/day)	--	--	--
Alum (lbs/day)	--	--	--
Oxygen (lbs/day)	--	66,850 (6F,6G, 6H,7F, 7G,7H)	--
Activated Carbon (lbs/day)	--	25,200 (8F,8G, 8H)	--
Labor (manhours/year)	55,990 (9F)	59,340 (average)	62,590 (6G,7G, 6H,7H)
Energy (kwhrs/year)	37.30 x 10^6 (6H,7H)	49.69 x 10^6 (average)	61.75 x 10^6 (8F,8G)

TABLE 5-Gb

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT III (continued)

	Minimum[a]	Intermediate[a]	Maximum[a]
Effluent Characteristics			
To Truckee River			
Flow (MGD)	34.6 (F)	36.8 (G)	39.3 (H)
BOD_5 (lbs/day)	--	2,670	--
Suspended Solids (lbs/day)	--	4,673	--
NO_3-N (lbs/day)	--	1,869	--
PO_4-P (lbs/day)	--	234	--
Chlorine Residual (lbs/day)	--	367	--
Dissolved Oxygen (lbs/day)	--	2,637	--
Spanish Springs Land Disposal Site			
Water (MGD)	0.7 (H)	3.21 (G)	5.35 (F)
Stabilized Sludge (lbs/day)	34,400 (F)	38,600 (G)	43,300 (H)
Phosphorus (lbs/day)	--	2,036 (F,G,H)	--
Nitrogen (lbs/day)	1,833 (H)	2,479 (G)	3,022 (F)
Potassium (lbs/day)	--	0.5	--
Zinc (lbs/day)	193 (F)	216 (G)	242 (H)
Copper (lbs/day)	103 (F)	116 (G)	130 (H)
Nickel (lbs/day)	12 (F)	14 (G)	15 (H)
Cadmium (lbs/day)	10 (F)	11 (G)	12 (H)

TABLE 5-Gc

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT III (continued)

	Minimum (a)	Intermediate (a)	Maximum (a)
Capital Costs (millions 1975 dollars)	20.37 (6H,7H)	22.23 (average)	24.30 (8F)
Operation and Maintenance (thousands 1975 dollars)	1,212 (6F,7F)	3,140 (average)	5,112 (8H)
Present Worth(b) (millions 1975 dollars)	34.34 (6G,7G)	55.50 (average)	76.87 (8F)

NOTES: (a) ( ) Identifies alternative within the concept

(b) Calculated at 7 percent for 20 years (annual payments); present worth = 10.5940

Source: (E-20, K-1, E-21, E-22)

TABLE 5-Ha

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT IV

	Minimum[a]	Intermediate[a]	Maximum[a]
Plant Requirements			
Chemicals			
Chlorine (lbs/day)	--	1,600	--
Lime (lbs/day)	5,512 (6A,7A, 8A)	--	19,030 (6C,7C)
Ferric Chloride (lbs/day)	1,775 (6C,7C, 8C)	--	1,836 (6A,7A, 8A)
Alum (lbs/day)	--	53,425 (6A,7A,8A)	--
Oxygen (lbs/day)	--	69,041 (6A,7A, 6C,7C)	--
Activated Carbon (lbs/day)	--	25,205 (8A)	--
Labor (manhours/year)	66,170 (8A)	--	72,470 (6A,7A)
Energy (kwhrs/year)	35.19 x 10^6 (6A,7A)	--	58.64 x 10^6 (8A)
Effluent Characteristics			
To Truckee River			
Flow (MGD)	--	40	--
BOD_5 (lbs/day)	--	2,670	--
Suspended Solids (lbs/day)	--	4,673	--
NO_3-N (lbs/day)	--	1,869	--
PO_4-N (lbs/day)	234 (6A, 7A,6C,7C)	--	335 (6A, 7A,8A)

TABLE 5-Hb

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT IV (continued)

	Minimum [a]	Intermediate [a]	Maximum [a]
Chlorine Residual (lbs/day)	--	367	--
Dissolved Oxygen (lbs/day)	--	2,637	--
Aluminum (lbs/day)	--(6C,7C, 8C)	--	267 (6A, 7A,8A)
Calcium (lbs/day)	--(6A,7A, 8A)	--	--
Landfill Area			
Water (MGD)	0.01 (A)	--	0.20 (C)
Solids (lbs/day)	44,400 (C)	--	45,951 (A)
Nitrogen (lbs/day)	1,720 (C)	--	2,500 (A)
Phosphorus (lbs/day)	1,933 (A)	--	2,126 (C)
Calcium (lbs/day)	2,570 (A)	--	2,882 (C)
Iron (lbs/day)	--(B)	548 (A)	614 (C)
Potassium (lbs/day)	--	0.5 (A,C)	--
Aluminum (lbs/day)	--(C)	--	4,554 (A)
Zinc (lbs/day)	249 (C)	--	257 (A)
Copper (lbs/day)	133 (C)	--	138 (A)
Nickel (lbs/day)	16 (C)	--	16 (A)
Cadmium (lbs/day)	12 (C)	--	13 (A)

TABLE 5-Hc

OPERATING REQUIREMENTS, EFFLUENT PARAMETERS AND COSTS FOR CONCEPT IV (continued)

	Minimum[a]	Intermediate[a]	Maximum[a]
Capital Costs (millions 1975 dollars)	11.96 (6C,7C)	--	13.24 (8A)
Operation and Maintenance (thousands annual 1975 dollars)	1,464 (6C,7C)	--	5,629 (8A)
Present Worth[b] (millions 1975 dollars)	24.47 (6C,7C)	--	72.93 (8A)

NOTES: (a) ( ) Identifies alternative within the concept

(b) Calculated at 7 percent for 20 years (annual payments); present worth = 10.5940

Source: (E-20, K-1, E-21, E-22)

- Concept IV to include:

  Treatment Alternatives 6, 7 and 8

  Disposal Alternatives A, B and C

- A final concept, that of no action, is also carried to final analysis

OVERVIEW OF WASTEWATER TREATMENT/SLUDGE HANDLING CONCEPTS

As brought together on the preceding pages there is one no action alternative and four action concepts to be reported upon.

No Action Alternative

Under this alternative, the plant facilities under consideration would not be expanded or upgraded. This alternative would preclude all design work or construction with the following consequences:

> If additional plant facilities are not constructed and the projected growth rate is realized, the treatment facility will be overloaded by 1978. Effluent quality would decrease considerably. The plant would not be able to comply with requirements for upgraded sludge handling, and by 1983 it could not comply with regulations on phosphorus removal.
>
> An evaluation of the no action alternative, including plant requirements and effluent characteristics for the year 1995, has been presented in Table 5-D. These projections are based on the following assumptions: that the plant operations would not change, and that the plant would be operated by the same number of personnel.

Action Alternative Concepts Effects

In the following paragraphs, patterns that certain parameters follow with respect to each of the four concepts are discussed. Although the summary tables on these concepts (Tables 5-E through 5-H) considered only a fixed rate of flow increase (40 MGD by 2000), it is anticipated that the same general trends will be apparent and proportional for lesser, or even zero, growth rates in flow through the JWPCP.

- Effluent Discharge

Alternate Concepts I and III contain the land treatment alternatives requiring the export of water to Spanish Springs Valley. Consequently, a certain amount of the effluent water would not return to the surface flow of the Truckee River. The relative volumes of water which would be diverted are dependent upon the amount required to pump the sludge to the site, and the amount required for irrigation of the crop to be grown there. Estimates of these volumes are presented in Tables 5-E and 5-G, and range from 5.4 MGD (approximately 6,050 acre-feet/year) to 0.7 MGD (approximately 785 acre-feet/year) depending upon the alternative and the operation of the land treatment site. The impacts of the diversion to Spanish Springs Valley under the irrigation alternatives are discussed in detail in Chapter 6.

Under the land treatment system, two pipelines will be necessary to convey the liquid digested sludge (6-inch diameter pipe) and the phosphorus-rich supernatant or plant effluent (10-inch diameter). At the site, ponds for winter storage of the sludge and a portion of the phosphorus-rich supernatant or effluent would be needed. Sprinkler systems, pumping facilities and dike construction to collect runoff would also be needed. During winter, when irrigation is impossible, alternate methods of disposing of the supernatant include sub-surface leaching (F) and lime treatment, and disposal via the Truckee River (G). Alternative H, which is also part of Concepts I and III, would provide a flexible program to utilize the PhoStrip supernatant as supplemental irrigation water on an "as needed" basis throughout the year, while maintaining the lime treatment operation when supplemental irrigation water is not required.

Alternate Concepts II and IV would discharge the entire plant effluent into the Truckee River, and dispose of the dewatered sludge by means of stock piling (A, C) or incineration (B). The total dry solids generated at 40 MGD will equal 60,000 lbs/day.

- Chemical Requirements

  Chlorine requirements for all four concepts are identical since it is used only for disinfection and dose levels should not change given comparable flows.

  Concept I appears to require the least amount of chemicals. One alternative in Concept I would require only chlorine. For those cases of less irrigation with PhoStrip supernatant, more lime is required until the levels reach 12,625 lbs/day (Alternative H). Concept II has a much higher range of chemical requirements due to phosphorus removal techniques employed in Alternatives A, B, and C. Concept III is similar in requirements to Concept I, except that the modified activated sludge processes require activated carbon and a purer form of oxygen. Concept IV is the combination of alternatives that requires the greater amount of chemicals due to the combination of modified activated sludge processes and chemical phosphorus/sludge treatments.

- Labor Requirements

  The range of man-hour requirements for the irrigation oriented concepts (I and III) are less than those for Concepts II and IV. One alternative in Concept II has a manpower level in the range of those for Concepts I and III, but this is the exception. The irrigation oriented concepts would require only 25 to 30 personnel (which includes present employees) as opposed to the unit process sludge handling alternatives which would require 30 to 36 personnel.

- Energy Requirements

  Concept I has the lowest energy requirements since it involves irrigating sludge and installing improved air diffusion systems for the activated sludge process. Only a few of the alternatives in Concept II require less energy than those in Concept I since incineration in sludge treatment requires a very high energy input. Technical restrictions prevent Concept IV from exhibiting the same trend. Energy requirements of Concept III are consistently high, but are not greater than some alternatives in Concept IV.

- Plant Outputs

  The sewage treatment facility will produce two types of output from the plant influent. The main body of water will be discharged to the Truckee River with a large portion of its potential pollutants removed. In the water purification process, a quantity of sludge is produced. The treatment and disposal of this sludge constitutes the second discharge.

- Effluent Discharge

  The principal variation in effluent discharge is reflected in both water quantity and gross weight of solids. For example, those alternatives (Concepts I and III) entailing irrigation will result in less water and solids being released directly back into the Truckee River system. Water applied to the irrigation site at Spanish Springs will not immediately re-enter the Truckee River system, but will serve to augment the groundwater supply.

  For those alternatives in Concepts II and IV that entail physical-chemical precipitation of phosphorus, there is an additional consideration. Although the plant effluent volume is almost equal to that of the influent, there is a residual of calcium, aluminum, or both that will be carried with the effluent into the Truckee River system. The levels involved are indicated in the summary Tables 5-F and 5-H for Concepts II and IV.

- Sludge/Supernatant Discharge

  The essential difference between irrigation and on-site sludge dewatering is that irrigation does not require expensive sludge handling unit processes. In addition, irrigation offers the opportunity to return water and nutrients to the land. Those concepts which involve chemical precipitation inherently produce greater amounts of sludge. For the case of irrigation with phosphorus-rich PhoStrip supernatant, the same quantity of phosphorus will be applied to the land as would have been if the phosphorus were lime precipitated from the supernatant. The difference is the form of

phosphorus used in each phase: in the supernatant, it will be dissolved phosphate, and in the sludge, phosphorus will be part of the calcium hydroxapatite precipitate ($Ca_5OH\ [PO_4]_3$).

In chemical precipitation, the aluminum and/or calcium levels in the produced sludge are also likely to be higher than normal.

- Economic Analysis

  Although a few alternatives in Concepts II and IV are inexpensive, it is evident that Concepts I and II have the lowest present worth range. Alternative C in Concepts II and IV consistently had lower capital and operation and maintenance costs as well as lower present worth value. In Concepts I and III, Alternative H had the lowest capital costs, Alternative F the lowest operation and maintenance costs, and Alternative G the lowest present worth value. Estimated costs for each alternative are presented in Tables 5-E through 5-H.

- Miscellaneous

  Alternative B developed by Kennedy Engineers, Inc. entails operating a sludge incinerator which can only be applied in Concept II. The great amounts of energy required and the resulting atmospheric discharges would have to be fully considered before implementation. A more detailed description of sludge incineration costs is given in Table 5-F.

OVERVIEW OF SEWER LINE ALTERNATES

The initial screening of sewerage systems resulted in the no action alternate and two route alternates for each project being identified for further comparison.

No Action Alternate

Should no action be taken to provide an expanded sewage collection system, area residents could be exposed to infectious microorganisms. Overloaded sewers in Reno periodically back up and discharge sewage into the streets. With existing conditions already critical, a no action decision could also halt growth in the downtown Reno area. Developments west of Reno would be forced to install individual

treatment facilities which potentially could lead to serious water quality problems in the Truckee River which is Reno-Sparks' domestic water supply. Growth of Reno's tourist industry would cease in those areas affected by the project.

Should no action be taken to construct the Lawton-Verdi Sewer, septic tanks, community treatment plants, and stabilization ponds of questionable efficiency will be drawn into greater usage. Wastes from septic tanks and these types of facilities will ultimately find their way into the groundwater table and also into Truckee River above the Reno-Sparks domestic water supply, creating health hazards. The number of individual treatment facilities could make effective monitoring of the effluent flows very difficult. The combined effect will be that the generally high water quality standards of the Truckee River Basin will not be effectively maintained.

Route Descriptions for Final Evaluation

- The Lawton-Verdi Interceptor Sewer

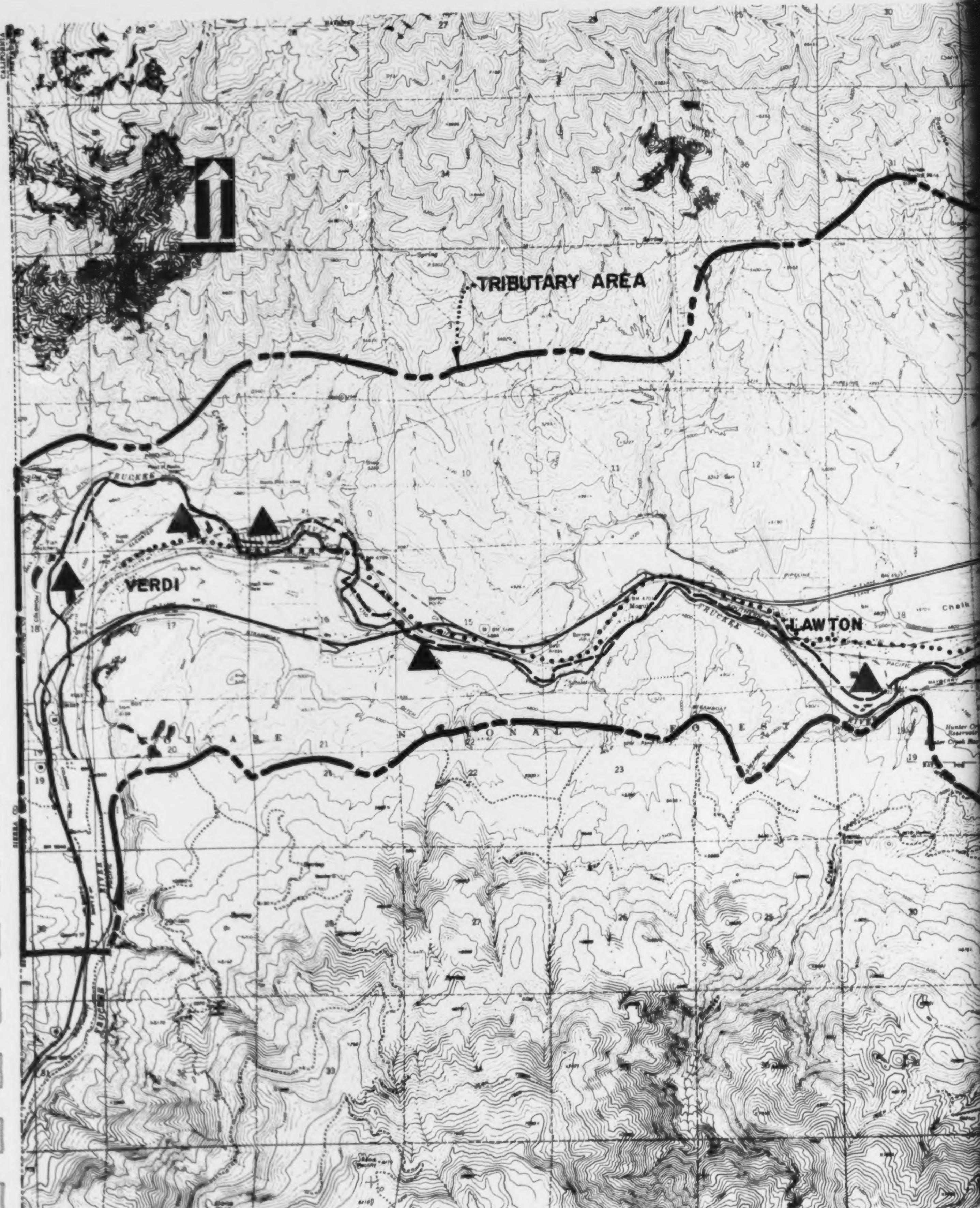
  River Route

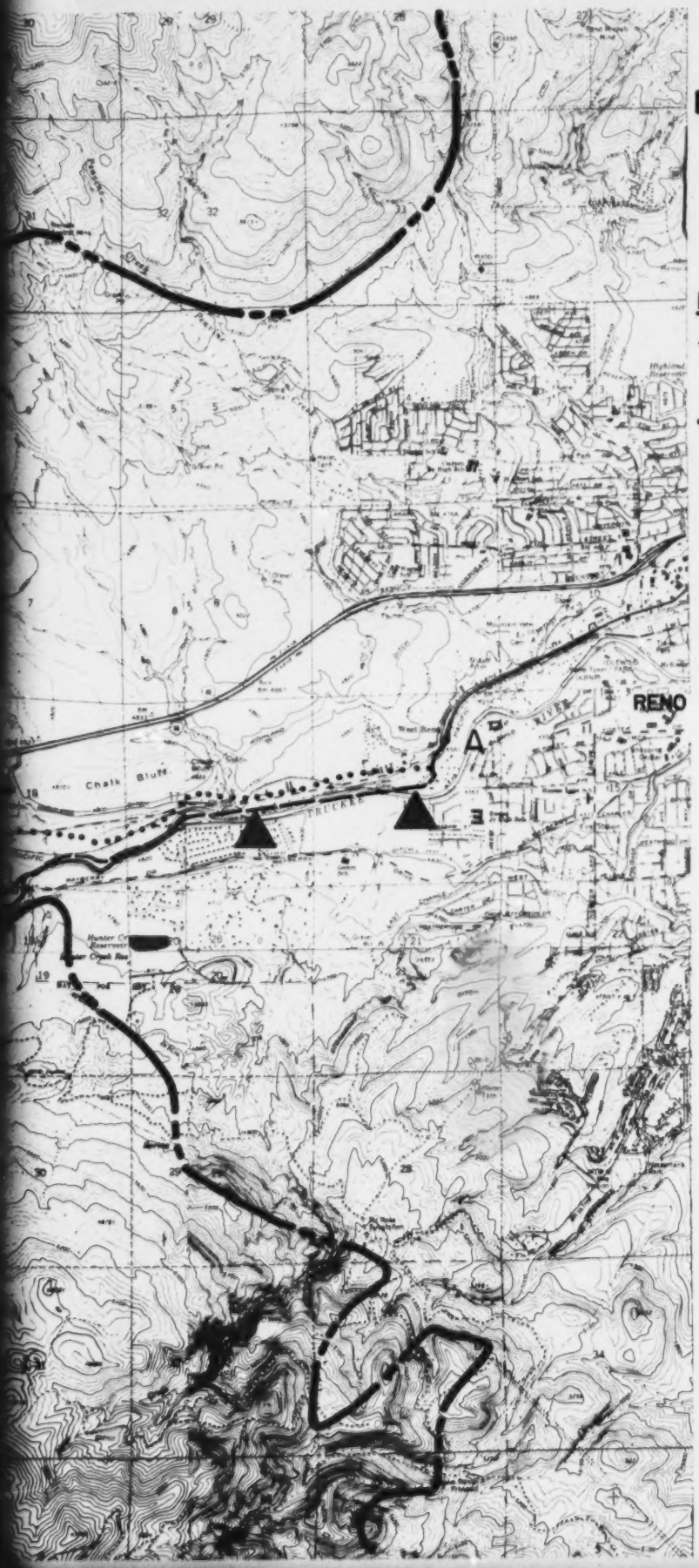
  Near the western end of Dickerson Road, the pipeline connects to the existing Dickerson Road Interceptor. It will then proceed west between the railroad and Highway 40 to a point just east of Orr Ditch, crossing under the railroad to the south approximately 100 feet to a point shown as Point A on Figure 5-4. Turning west and proceeding to Jolly Lane, west in Jolly Lane to Del Curto Drive, south in Del Curto, across a vacant field, and crossing the Truckee River to a point west of Idlewild Drive and Sumac Street. The line will then continue west through fields adjacent to and south of the Truckee River to the eastern end of River Lane, west in River Lane paralleling the river and behind the tree line, beneath the new Mayberry Bridge and crossing the river to the north in the vicinity of Aspen Glen Road. The interceptor continues west, paralleling and on the north side of the river. Southeast of Lawton near White Fir Drive, U. S. 40, and Business 80, this alignment crosses to the south side of the Truckee River, continuing west and south of Mogul the alignment crosses the river five times and is north of the Truckee River in the vicinity of the Sub-station Powerhouse. East of the Powerhouse the alignment crosses to the south side of the Truckee River and continues west to the intersection of the Truckee and Highway 80. Then proceeding northwest and

adjacent to the river, the alignment crosses to the north side of the river, continuing north west and crossing the river to the south at the railroad. Continuing on the south side of the river to Riverbend where it crosses to the north shore and continues west, south of the trailer park to a point near U.S. 40 and the river, crossing the river to the south, beneath U.S. 40 and west adjacent to the river to Verdi. River crossings, sewer laterals and the general alignment described above are shown on Figure 5-4.

Railroad Route

Beginning near the western end of Dickerson Road, with a connection to the Dickerson Road Interceptor, the pipeline proceeds west, between the railroad and Highway 40 to a point just east of the Orr Ditch, then crossing under the railroad to the south approximately 100 feet to a point which is shown as Point A. This alignment continues west, south and parallel of the railroad to a point approximately 600 feet west of Twin Lakes Drive where it crosses to the north side of the railroad, continuing west to a point opposite Livermore Drive and then crossing to the south side of the railroad. Continuing west adjacent to the railroad and crossing the railroad to the north, northeast of the new Mayberry bridge. Continuing west on the north side of the railroad tracks to a point west of White Fir Drive, then crossing to the south side of the tracks and continuing west crossing the north of the tracks near the golf course east of Mogul. Continuing westerly, north of the railroad to the Powerhouse Sub-station area where it crosses both tracks of the railroad to the south. Then traversing the area between the railroad and the Truckee River to the intersection of the northern railroad tracks and the Truckee River. Crossing the river with the railroad, and continuing west on the north side of the railroad to a point west of Harker Mobile Home Park, then turning north to the south side of Highway 40 and continuing west to Verdi. Sewage lift stations and river crossings for lateral connections for this alignment are shown on Figure 5-4.


TRIBUTARY AREA
VERDI
LAWTON
TRUCKEE
RIVER
PACIFIC



LAWTON-VERDI INTERCEPTOR ALTERNATES

LEGEND

——— RIVER ALTERNATE

..... RAILROAD ALTERNATE

▲ PUMP STATION

FIGURE 5-4

0 4000 8000 12000

SCALE

- The Cross-Town Sewer

Alternate AB

This alternate will extend west from the existing Mill Street Interceptor at Mill Street and Kirman Avenue. The interceptor then proceeds west down Mill Street. Mill Street is primarily residential with scattered commercial buildings. The interceptor continues west in Mill Street into the downtown district. At Virginia Street the interceptor turns north for one block, and then turns west on Island Avenue south of and adjacent to the Truckee River. Then west in Island Drive to Arlington Avenue where the interceptor turns north, crossing Wingfield Park and both branches of the Truckee River to First Street. AB then turns west on First Street to Riverside Drive and southwest on Riverside Drive to Jones Street, as shown on Figure 5-5.

Alternate CD

This alternate will connect to the existing Mill Street Interceptor at Kirman Avenue near the Washoe Medical Center. From this point the interceptor proceeds west down Mill Street. Mill Street is generally four traffic lanes wide with parking on both sides of the street. Mill Street is primarily residential with scattered commercial buildings. The interceptor continues west in Mill Street into the downtown district. West of the Lake Street, Mill Street tapers to two traffic lanes with metered parking and motels on both the north and south side. The interceptor continues in Mill street to Virginia Street, where it turns north on Virginia Street past the Riverside Hotel (one block), and then turns west on Island Avenue adjacent to the Truckee River, then west in Island Avenue crossing Arlington Avenue through the southern portion on Wingfield Park to the terminus of Island Avenue at the Truckee River. Alternate CD will then cross under the river to the intersection of Riverside Drive (Reno Scenic Drive) and Jones Street (see Figure 5-6).

Descriptions of Alternates AB and CD both terminate at Riverside Drive and Jones Street. Sub-alternates to both alternates can be considered at this point.

Preceding page blank

Sub-alternate R will continue Alternate AB or Alternate CD from Riverside Drive and Jones Street by running the pipeline west in Riverside Drive to Booth Street, with connection to the Dickerson Road Interceptor.

Sub-alternate J will continue Alternates AB or Alternate CD west in Jones Street from Riverside Drive to a connection with the Dickerson Road Interceptor at the western end of Jones Street.

Action Alternate Effects

- The Lawton-Verdi Interceptor Sewer Routes

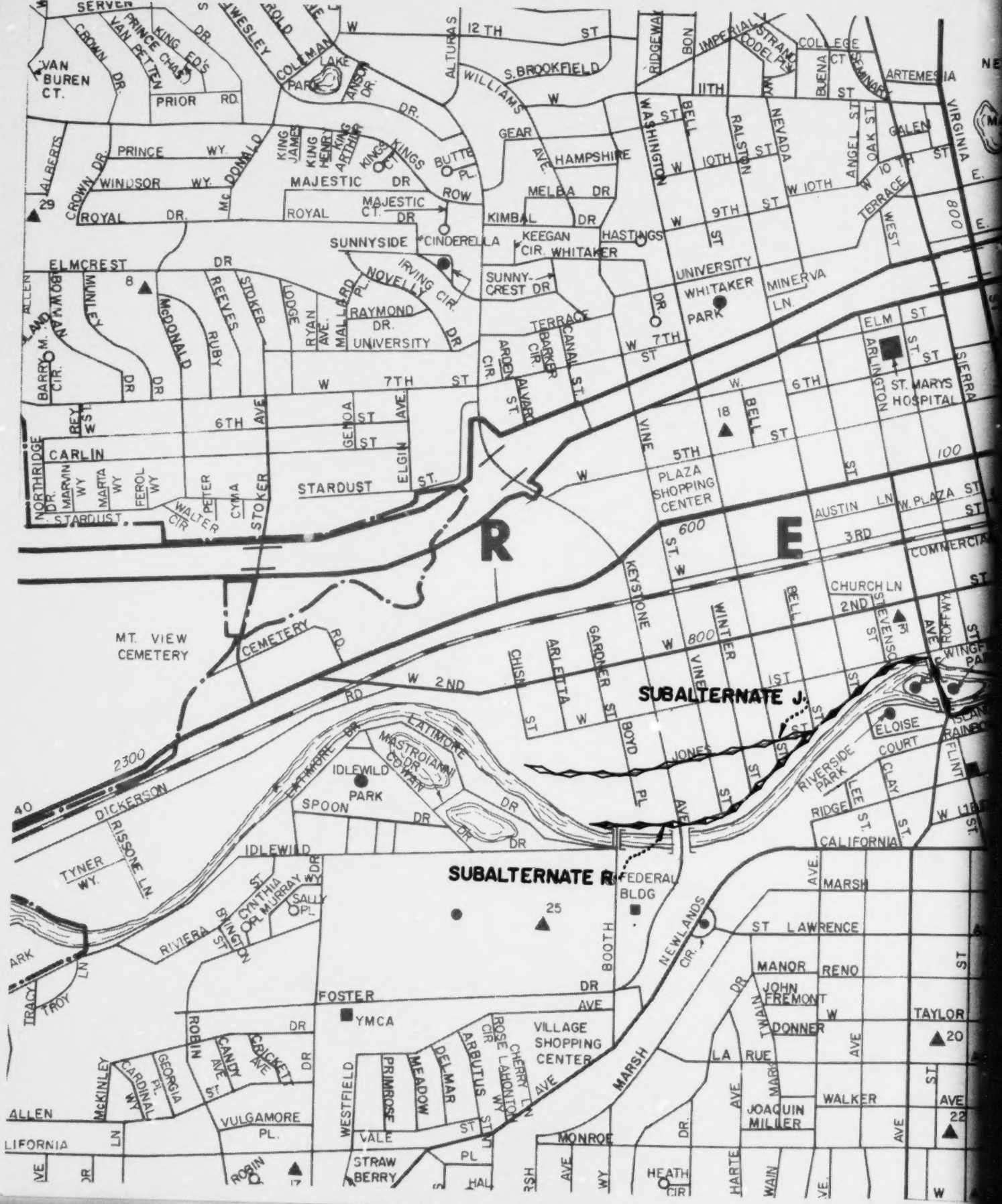
River Route

Material cost - Although both Lawton-Verdi routes begin and terminate at approximately the same location, Alternate 1 will require 11,600 linear feet more pipe than Alternate 2. This difference can be directly related to the meander distance of the river. The cost of river crossings is also high for this alternate because of the number of such crossings and necessity for minimizing infiltration.

Construction and maintenance access - Continuing maintenance will require construction of access roads capable of supporting heavy equipment. Initial construction and maintenance access will therefore necessitate extensive landscape restoration.

River disturbance - Preliminary design indicates that nine river crossings will be required plus crossings to provide sewer service for areas on the opposite side of the river. The river crossing can be constructed in stages and at no time will river flow be completely restricted. There will be disturbance of settled silts and other deposited soils which river currents will redeposit further downstream.

Labor and energy consumption - Labor and equipment required for construction will be of the variety typical for underground construction. There will be no long term energy consumption because the alignment does not require pumping to maintain flows.


SUBALTERNATE J.
SUBALTERNATE R.
R
E
MT. VIEW CEMETERY
CEMETERY RD.
IDLEWILD PARK
SPOON DR.
LATIMORE DR.
MASTROIANNI COURT
RIVERSIDE PARK
ELOISE COURT
FEDERAL BLDG
NEWLANDS CIR.
VILLAGE SHOPPING CENTER
YMCA
FOSTER DR.
ST. MARYS HOSPITAL
WHITAKER PARK
UNIVERSITY
PLAZA SHOPPING CENTER
SUNNYSIDE
CINDERELLA
MAJESTIC DR.
ROYAL DR.
ELMCREST DR.
CARLIN
STARDUST
DICKERSON
TYNER WY.
RISSONE LN.
RIVIERA
MARSH
ST LAWRENCE
MANOR
RENO
TAYLOR
DONNER
LA RUE
WALKER
JOAQUIN MILLER
MONROE
HEATH CIR.
STRAWBERRY
VULGAMORE PL.
ALLEN
CALIFORNIA
CHURCH LN
2ND
3RD
AUSTIN LN
W. PLAZA ST
COMMERCIAL
ELM ST
6TH
7TH
10TH
9TH
11TH
12TH
S. BROOKFIELD
WILLIAMS
GEAR
HAMPSHIRE
MELBA DR
KIMBAL DR
HASTINGS
KEEGAN CIR.
WHITAKER
MINERVA LN.
VIRGINIA
ARTEMESIA
COLLEGE
BUENA
GALEN
ANGEL ST.
OAK ST.
TERRACE
WEST
800
100
600
2300
40
25
20
22
18
8
9

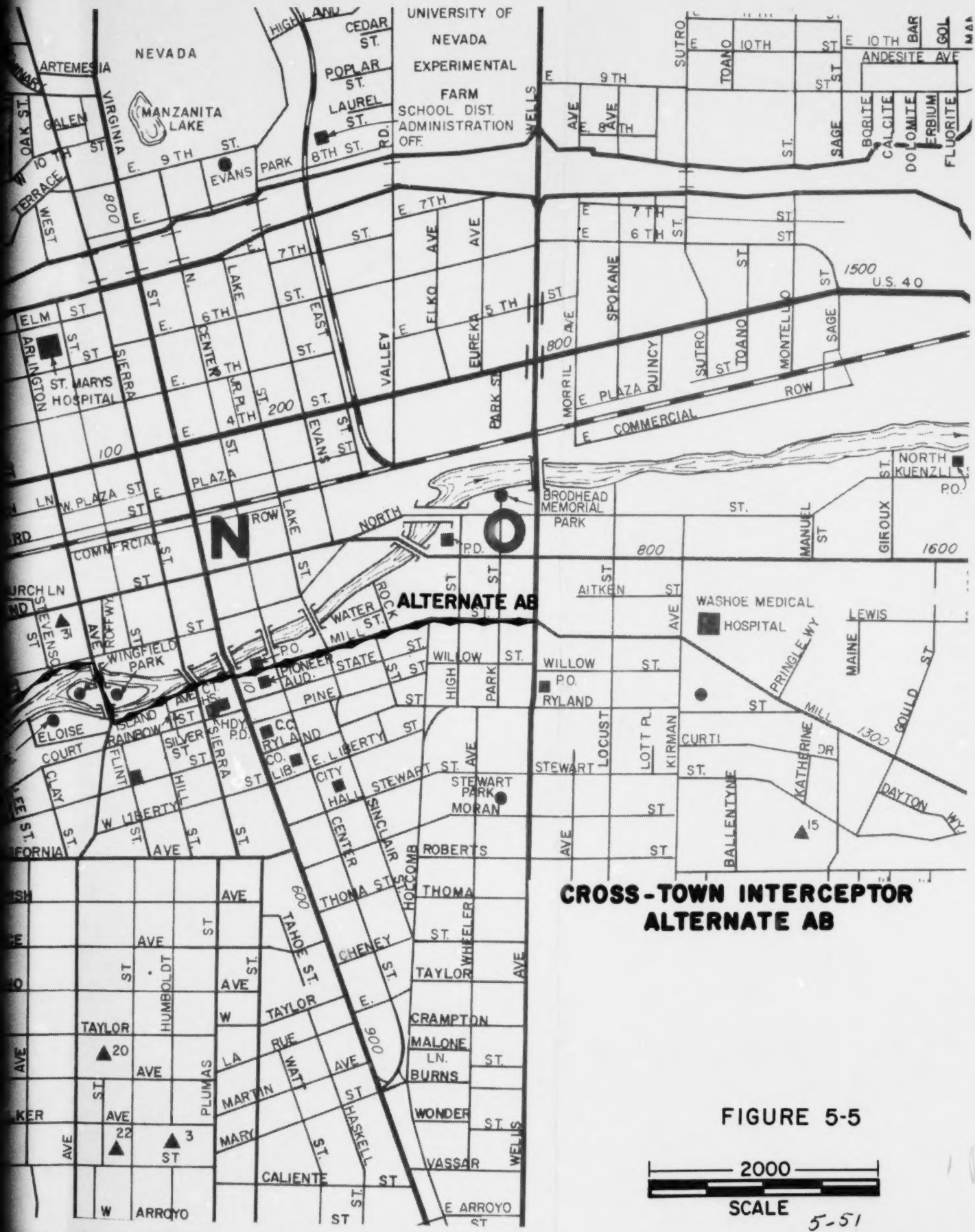
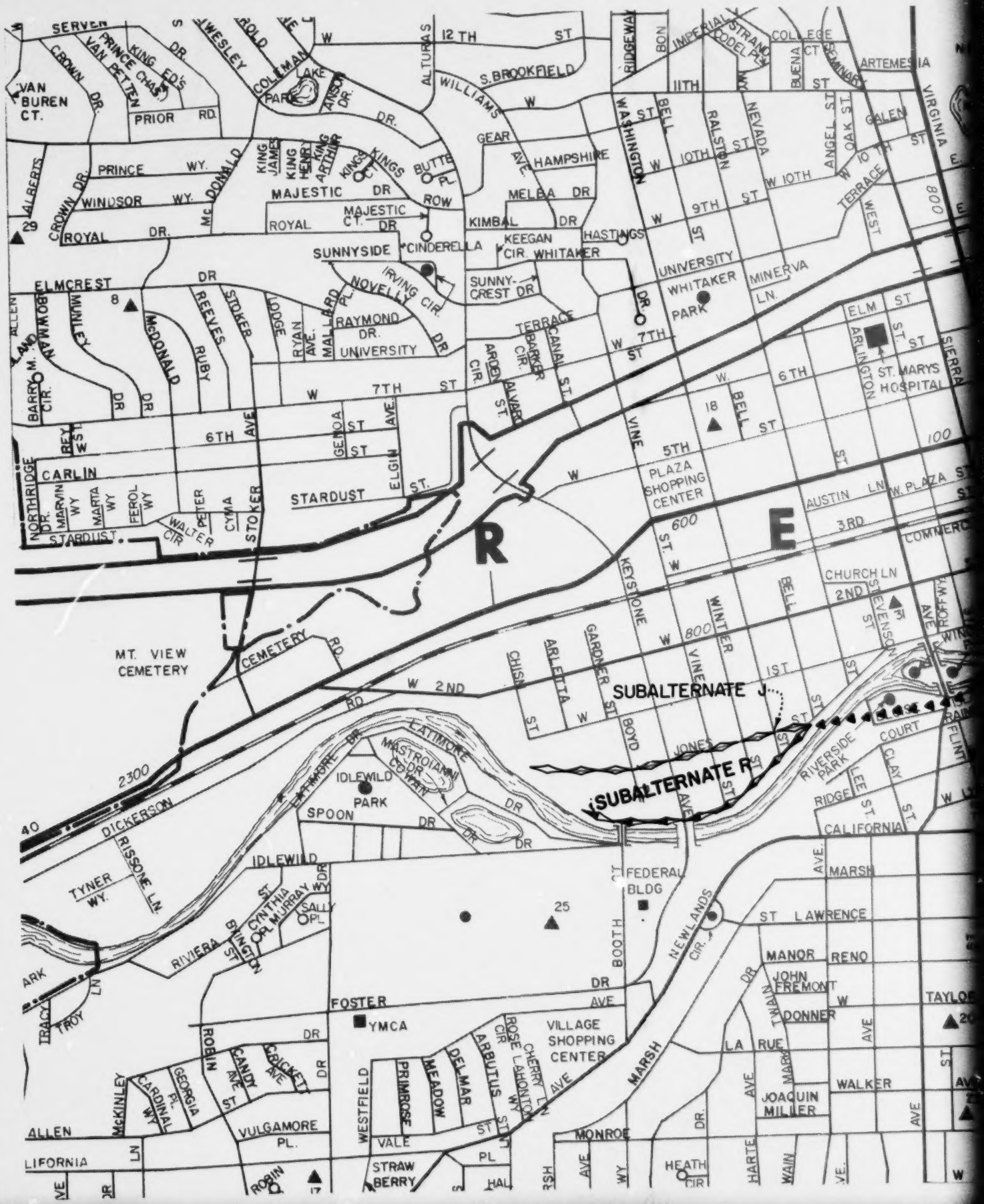

UNIVERSITY OF NEVADA EXPERIMENTAL FARM
SCHOOL DIST. ADMINISTRATION OFF.
NEVADA
ARTEMESIA
MANZANITA LAKE
EVANS PARK
ST. MARYS HOSPITAL
BRODHEAD MEMORIAL PARK
WASHOE MEDICAL HOSPITAL
WINGFIELD PARK
STEWART PARK
ALTERNATE AB
U.S. 40
CROSS-TOWN INTERCEPTOR
ALTERNATE AB
SCALE
2000

FIGURE 5-5


SUBALTERNATE J
SUBALTERNATE R
R
E
MT. VIEW CEMETERY
CEMETERY RD
W 2ND
DICKERSON
2300
40
IDLEWILD PARK
SPOON DR
CATIMORE DR
MASTROIANNI DR
COWAN DR
IDLEWILD
TYNER WY.
RISSONE LN.
RIVIERA
CYNTHIA PL
MURRAY WY
SALLY PL
FOSTER
YMCA
FEDERAL BLDG
BOOTH
NEWLANDS CIR.
VILLAGE SHOPPING CENTER
MARSH
ST LAWRENCE
MANOR
RENO
JOHN FREMONT
DONNER
LA RUE
WALKER
JOAQUIN MILLER
MONROE
HEATH CIR
HARTE
WAIN
TAYLOR
CALIFORNIA
RIVERSIDE PARK
LEE
CLAY
COURT
FLINT
RIDGE
ROBIN
CANDY AVE
CRICKET AVE
McKINLEY
CARDINAL WY
GEORGIA PL
ALLEN
VULGAMORE PL.
WESTFIELD
PRIMROSE
MEADOW
DELMAR
ARBUTUS
ROSE LAMONTA CIR
CHERRY LN
VALE
STRAW BERRY
HAL
LIFORNIA
TRACY
TROY
ARK
VAN BUREN CT.
PRIOR RD
PRINCE WY.
WINDSOR WY.
ROYAL DR.
CROWN DR
ALBERTS
McDONALD
KING JAMES
KING HENRY
KING ARTHUR
KINGS CT
KINGS
BUTTE PL
MAJESTIC DR
MAJESTIC CT.
ROYAL DR
SUNNYSIDE
CINDERELLA
IRVING CIR
NOVELLY
RAYMOND DR.
UNIVERSITY DR
ELMCREST DR
BOWMAN
WINTLEY
REEVES
RUBY
STOKER
LODGE
RYAN AVE.
MALLARD PL
BARRY M. CIR
NORTHRIDGE DR
MARVIN WY
MARTA WY
FEROL WY
PETER
CYMA
WALTER CIR
STARDUST
CARLIN
6TH AVE
GENOA ST
ELGIN AVE
7TH ST
ALTURAS
12TH ST
S. BROOKFIELD
WILLIAMS
GEAR AVE
HAMPSHIRE
MELBA DR
KIMBAL DR
KEEGAN CIR
WHITAKER
HASTINGS
SUNNY-CREST DR
TERRACE
PARKER CIR
ARDEN CIR
ALVARD ST
CANAL ST
VINE
5TH
PLAZA SHOPPING CENTER
KEYSTONE
GARDNER ST
ARLETTA
CHISM ST
BOYD
JONES
WINTER
VINE
BELL ST
STEVENSON
ROFFWY
CHURCH LN
2ND
1ST
3RD
AUSTIN LN
W. PLAZA
COMMERC
ELM ST
ARLINGTON
ST. MARYS HOSPITAL
SIERRA
6TH
W. BELL ST
7TH
WASHINGTON
RIDGEWAY
11TH
10TH
9TH
RALSTON ST
NEVADA
ANGEL ST
OAK ST
GLEN
VIRGINIA
ARTEMESIA
COLLEGE
BUENA
IMPERIAL
STRANO
COLEMAN
LAKE PARK
ANSON DR
WESLEY
PRINCE CHAS
KING ED'S
VAN BETTEN
SERVEN
W 10TH
TERRACE
WEST
MINERVA LN.
UNIVERSITY
WHITAKER PARK
800
100
600
800
2300
25
29
8
18
20

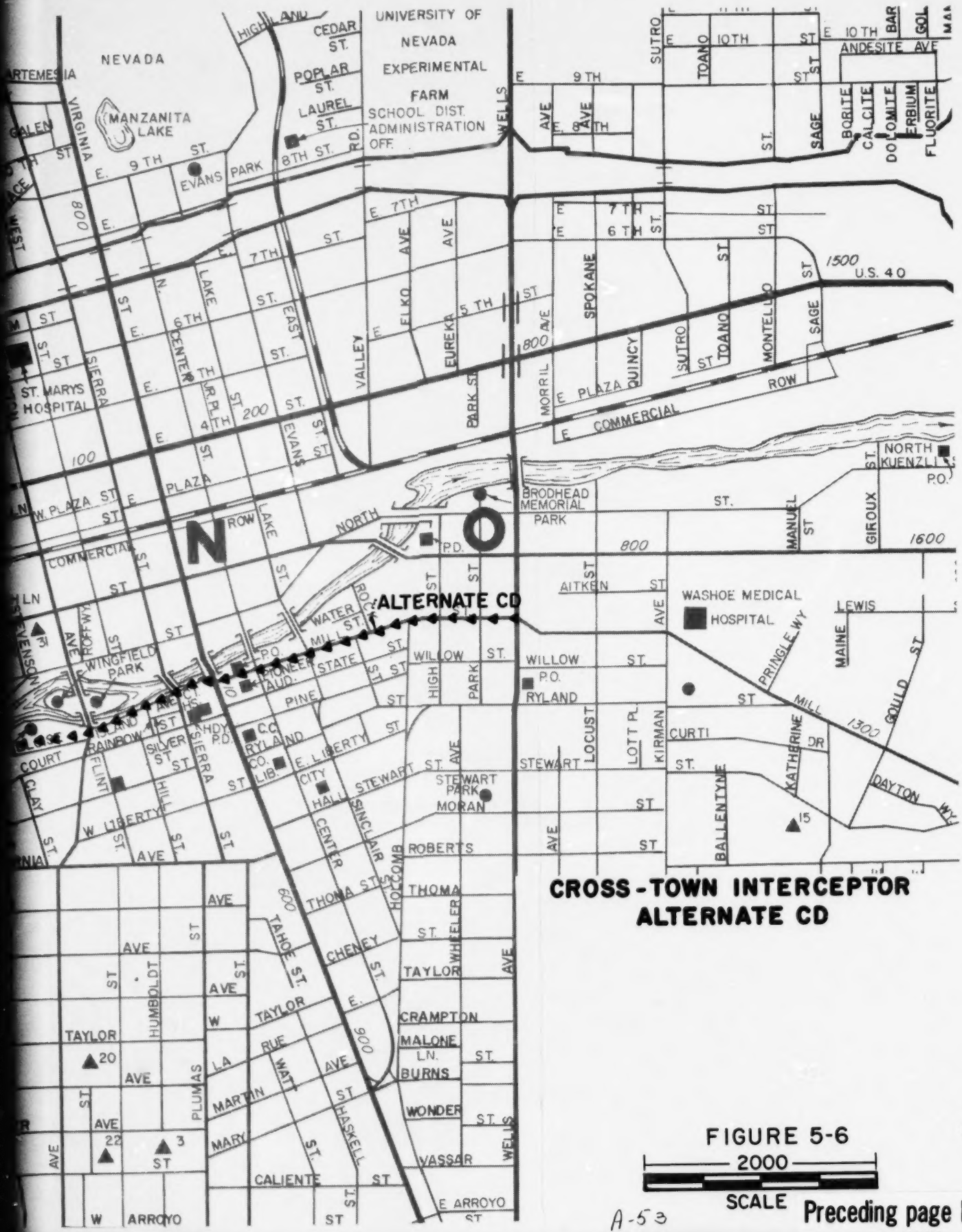


FIGURE 5-6

2000

SCALE

A-53

Preceding page blank

Railroad Route

Material Cost - This route following the generally straight alignment of the Southern Pacific Railroad requires only 48,500 linear feet of pipe. To span the canyons approximately 3900 linear feet of trestle may be needed. The construction of sewage lift stations serving low lying areas is also a major expense.

Contruction and maintenance access - Construction for maintenance access will be less than for the other route by utilization of existing cleared space adjacent to the railroad tracks. This cleared space will reduce the need for landscape restoration.

River disturbance - The interceptor alignment does not cross the river; however there will be four crossing of small diameter pipe serving areas across the river from the interceptor resulting in some redistribution of settled river bed soils.

Labor and energy consumption - Labor and equipment required for construction will be more sophisticated than that used for the River Alternate because of tunneling, and trestle construction operations. Energy used to operate sewage lift stations will be subject to increasing annual energy cost and is estimated at $41,531 for 20 years of operation, with full development of the tributary areas.

- The Cross-Town Sewer

Alternate AB

River disturbance - This alternate crosses both branches of the Truckee River at Wingfield Park and Arlington Avenue. The flow can all be diverted to one channel while construction is proceeding in the other. The river is channelized in this area and the crossings may require syphon type structures to attain sufficient depth to clear beneth the channel.

Landscape restoration - Landscape restoration will be required in Wingfield Park and will generally consist of lawn replacement. Care should be exercised in the office design and in field operations to protect existing trees within the park.

Preceding page blank

Traffic disruption - Minor traffic problems will be created by interceptor construction with the exception of the one block of construction in Virginia Street near Arlington. Effective methods of routing some percentage of Virginia Street traffic to paralleling streets may be required. All construction in local streets will tend towards driver distraction and will require traffic control.

Commercial activity and property access - Commercial activity and property access will be somewhat restricted by trenches and construction equipment. Individual homes may be denied use of their driveways for several days. Commercial operations having extensive or alternate frontages will suffer little inconvenience.

Alternate CD

River disturbance - Alternate CD requires crossing the Truckee River only once, west of Wingfield Park. The river is not channelized at this point and more extensive river controls will be necessary to construct the crossing.

Landscape restoration - Landscape restoration in Wingfield Park will be slight because the interceptor can be located in a non-improved park access road. Rip-rap along the river channel and the adjacent landscape at the crossing can be replaced with no long term adverse effects.

Traffic disruption - The same traffic problems experienced above will be created by this interceptor construction. Both alternates will require traffic control, although Alternate CD reduces traffic control needs somewhat by its alignment through southern Wingfield Park.

Commercial activity and property access - Commercial activity and property access will be restricted by construction operations as outlined above for the other alternate.

Sub-alternate J, Jones Street

Landscape restoration - Interceptor routing down Jones Street will displace no landscape. There is some potential danger to root systems of trees lining Jones Street, but there should be no extensive long term damage.

Traffic disruption - Several streets paralleling Jones Street may be used for detouring residential traffic, with the exception of the western end of Jones Street, where apartment buildings have only Jones Street for access. The Keystone Avenue Bridge traffic will be interrupted as the alignment crosses Keystone Avenue.

Property access - Individual homes facing Jones Street may be without access to their driveways for a short period.

Noise - The character of the area around Jones Street is relaxed and quiet. Construction operations will increase noise levels in this area.

Sub-alternate R, Riverside Drive

Landscape restoration - Interceptor routing in Riverside Drive presents potential danger to adjacent tree root systems. The narrowness of Riverside Drive may make it necessary to operate or store equipment behind the curb line but damage from such procedures will not be irreversible. The interceptor could run through the Parkway south of the street with accompanying impacts on the landscaped areas.

Traffic disruption - Riverside Drive is part of the Reno Scenic Drive. As traffic is restricted or rerouted, its function as a scenic route will temporarily cease. Access to apartment buildings near Riverside Drive and Booth Street will be limited. Traffic normally crossing the Booth Street Bridge may be detoured to another crossing, such as the Keystone Avenue Bridge.

Property access - Access to apartment buildings near Booth Street and access to driveways along Riverside Drive will be limited; this inconvenience is applicable to two blocks along the north side of the street.

Noise - Construction operations will increase neighborhood noise levels and interfere with the characteristic usage of the adjacent pedestrian parkway.

CHAPTER VI

IMPACTS OF THE PROPOSED ACTIONS

INTRODUCTION

Chapter Format

This chapter examines the impacts of the proposed project on various aspects of the environment. Following the earlier established format, impacts will be discussed first in the framework of the JWPCP service area. Impacts at this regional level are primarily the result of population derived secondary impacts. These impacts are not sensitive, for the most part, to alternative project design concepts; they are sensitive to the extent of treatment plant expansion and the sizing of interceptor sewer lines. This discussion is divided into factors reflecting little or no impact and factors reflecting primary impact.

The probable impacts on the project site environs will then be identified. For the JWPCP, this includes the area of the plant expansion itself, the sludge disposal site, the treated water disposal area, and the land reclamation and irrigation site. For the Reno Cross-Town Sewer and the Lawton-Verdi Interceptor, the site environs is the cordon through which the line will pass.

The final area of reported impact is the lower Truckee River from Vista to Pyramid Lake. Impacts on the ecosystem will be primarily directed toward the aquatic environment. In order to simplify the impact discussion, mitigative measures associated with the proposed action will be described in Chapter 7 with the discussion of unavoidable adverse impacts.

Impact Description

The description of probable impacts of any proposed action is a predictive exercise, and often the level of detail for evaluation is limited. In this analysis, every effort has been made to quantify (where possible and desirable) the predicted impacts of each alternative. These quantitative predictions have a greater degree of accuracy than subjective determinations such as "good" or "bad" and "high" or "low", and should provide a better basis for understanding probable environmental changes that may result from implementing the

alternatives or from doing nothing. However, quantification also draws criticism because a number is more easily disputed than a subjective judgment. Where qualitative judgments are made, they have been based upon information gained from similar projects already completed, a knowledge of the pre-project environment, and interpretations of probable effects of each proposed action. Where specific analysis techniques or available data do not lend themselves to measurement or comparison, descriptive terminology is employed. "Beneficial" and "adverse" are descriptive terms for effects which are desirable or undesirable as determined by existing standards (e.g., water quality, air quality, protection of endangered species) and the overall impact on the human environment. In some cases, the desirability of an impact may be disputed, depending on the standpoint from which it is viewed. For example, the additions of nutrients to surface waters may be beneficial to the growth of phytoplankton, but is considered undesirable if the water has a sufficient nutrient background or if it is to be used as drinking water.

"Short term" impacts are differentiated from "long term" impacts by the length of time involved. "Short term" effects result primarily from construction or implementation of the proposed action and "long term" refers to continuing effects usually related to operational procedures that will occur during the life of the project. Both short term and long term impacts can embody irretrievable losses or temporary effects.

"Primary" impacts are defined as those environmental effects which are the direct result of the proposed activity. "Secondary" impacts are indirectly related to the action and are usually the result of changes associated with primary impacts or the project itself. For example, changes in water quality in the receiving waters of a wastewater treatment plant resulting from plant effluent are considered primary impacts while the changes in runoff water quality that may result from urban development accommodated by expanding wastewater treatment services are considered secondary impacts.

Environmentally Sensitive Issues

As a final guideline to the reader, it seems appropriate to summarize the issues of prime significance which, at this stage in the study, have become apparent to the researchers. This perception of environmental sensitivity

is the result of inputs received in public meetings as well as from the on-going study process and results in a concentration of discussion on the important issues identified as follows:

- Compatibility of service extension with articulated general planning goals;
- Rationale for improved regional waste treatment and collection;
- Growth accommodation resulting in air quality degradation;
- Groundwater consequences of effluent disposal in Spanish Springs Valley;
- Sewer construction impacts within the upper Truckee Riverway (to Verdi);
- Water quality influences on the riverine fishery; and
- Water quality/quantity ramifications of the proposed project on Pyramid Lake and the lower Truckee River.

IMPACTS AT REGIONAL SCALE - FACTORS REFLECTING LITTLE OR NO PROJECT IMPACT

Topography

The sewer service area consists primarily of gently sloping lands lying east of the Sierra-Nevada mountains and west of the Pah Rah and Virginia Mountain Ranges. Urbanization patterns of past decades have developed outward from Reno and Sparks and have been restrained by topography and the availability of services.

The proposed project does not involve grading operations at a regional scale. Site-specific construction grading, discussed in the following section, will not alter the service area topography. However, the expansion of the Reno-Sparks Treatment Facility, the construction of the Cross-Town Sewer, and the construction of the Lawton-Verdi Interceptor will accommodate larger populations, and an

expanded urbanized area. Future grading as a result of urbanization is therefore an indirect impact of the proposed facilities.

It has been estimated in the Regional Land Use and Urbanization section of this chapter that, by the year 2000, projected development in the Reno-Sparks-Truckee Meadows will have occupied approximately one-third of the remaining land capable of supporting development* within the service area. In the Lawton-Verdi corridor, 38 to 59 percent of the land area potentially suitable for development will be consumed.

Scenic and Aesthetic Characteristics

Open valley and desert, mountain and river, urban and agricultural environments appealing to a variety of personal tastes may be enjoyed from locations throughout the service area. The existing mixed aesthetic environment will undergo a gradual shift with increased urbanization.

Specifically, acricultural land uses east, south and west of Reno will be replaced by low to medium density residential use and attendant commercial and industrial development in accordance with the General Plan. As with topography, secondary area-wide aesthetic effects of the project are limited to surface impacts which are most noticeable at the micro level. Such effects will not impair the overall grandeur of the region, but they will change the local character of individual locations throughout the service area as urbanization expands.

Quantification of visual impact can be related to projected land use changes. Open valley, desert, agricultural and some hillside property, viewed now as open space, will be converted to residential and ancillary commercial, industrial, municipal uses of a character similar to that of the newest development in the area. The land area visually impacted by this change in land use as accommodated by the proposed action, will be approximately twice as large as the currently urbanized portion of the Truckee Meadows.

*Developable land is considered to be the gross area within the sewer service boundary reduced by local land use constraints imposed by hillsides, floodplain designation, and open space reservation.

Climate

The residential development associated with the projected growth in population to the year 2000 will convert an appreciable amount of the irrigated cropland within the Truckee River Basin to urban land (see Chapter 4). A land use change of this nature is likely to alter local diurnal temperature, humidity and wind patterns, and possible precipitation rates. These parameters are affected by conversion of open cropland to impervious reflective surfaces, the emission of solid and gaseous pollutants, development of smog and subsequent reduction in sunlight attributable to urban pollution (L-7). The degree that regional climate and meteorological patterns will be affected is unknown, but is judged to be minor due to projected air pollution controls for the service area (i.e., automobile emissions controls, AQMA study recommendations for particulates) and the relative size of the urban area in relation to the topographically defined region.

Recreation

Recreation opportunities in the service area include the water oriented use of the Truckee River and Pyramid Lake. In addition, the alpine/desert valley environment comprising most of the study area, has abundant variety of flora and fauna study area, as described in Chapter 2, and offers an almost limitless stage for the appreciation of nature. Urbanization will create additional development along the Truckee River from Verdi to Reno. It will be very important to control this development so that recreation benefits of the river will not be impaired.

The project will facilitate an increase in population which in turn will increase the pressure on recreation and natural areas in terms of user day demands. The balance between residential and non-residential visitors as reported in Table 2-B may shift to include a higher percentage of residents. Based on current use of local and regional recreational areas, this shift can be expected to result in more user days at camping, swimming and picnicking facilities in the area.

Casinos and gaming facilities provide a well-known variety of entertainment, night life and recreation in the region. Extension of sewage facilities is important to support a

continued growth and expansion of this key recreation industry and to maintain a competitive position for the Reno area in respect to gaming facilities offered in other nearby regions.

Drainage and Flood Control

Presently, storm runoff is removed by underground conduit in the urbanized portions of Reno and Sparks and discharged into the Truckee River or its tributary. Natural swales and drainageways are used in the balance of the rural area. These unimproved conveyance systems comprise an acceptable present system of stormwater removal; however as development increases, these systems will become increasingly inadequate and new construction to upgrade and improve the system will become necessary. In areas, such as the Lawton-Verdi corridor, where an unusually rapid increase in development is possible, site improvements will generate a significant impact on drainage systems. An increase in the impervious surface area, combined with the construction of new drainage facilities to transport stormwater flows to outfall points, will cause an increase in the downstream peak flow rates and may add to the downstream flood hazard.

Unless properly controlled, urbanization associated with the proposed project will have an impact on the flooding problem as damages from flooding can be expected to increase if more extensive urban use of floodplain areas occurs. Development may cause additional local impacts by obstructing the floodplain with urban improvements such that the flood waters are forced to higher, more damaging elevations. However, if floodplain management and/or flood control facilities are planned in accordance with the Flood Insurance Act concomitant with urbanization, these effects would be reduced or eliminated. As development removes natural vegetative cover and silts and the chemical by-products of urbanization are introduced to floodwaters, water quality in the receiving waters is reduced accordingly.

Both the Federal Government Flood Insurance Program (H-13) and the United States Corps of Engineers (E-8) Flood Plain information reports on the Truckee River and the Truckee Meadows area contain information on past floods and maps, profiles and cross-sections that indicate the extent of flooding that can reasonably be expected in the future.

However, one of the most recent of these studies, The Flood Hazard Boundary Map for Washoe County, (H-13) prepared by the Federal Insurance Administration, has been subject to extensive review and has been rescinded as of March 6, 1976.

Acoustics

Project-facilitated urbanization will be accompanied by increased noise levels throughout the project service area. The U.S. Environmental Protection Agency (E-20) indicates that suburban areas and small town day-night exterior noise levels are acceptable in the 46 dBA to 55 dBA range. Noise measurements taken outside the Reno-Sparks Metropolitan Area (Samples 10, 11, 12, 13 - Chapter 2) indicate that current typical Ldn levels range from 32 dBA to 42 dBA. These areas are ultimately planned for low density urban development and should therefore be within the EPA noise limits of 55 Ldn recommended for residential land use.

Population growth outside the existing urban area will contribute additional noise as private and public vehicles are used in daily commutes, thus increasing roadway volumes. Day-night noise levels (Ldn) associated with certain average daily traffic have been predicted as shown in Table 6-A.

TABLE 6-A

TRAFFIC NOISE

Average Daily Traffic	Ldn (@ 50 feet from source)
1,000	65
5,000	73
10,000	76
20,000	79
30,000	81

Each traffic carrier must be evaluated on an individual basis to reasonably predict noise level increases over current levels. From the assumptions contained in the 1964 Truckee Meadows Area Urban Transportation Study, it is considered reasonable to assume increases in ambient noise levels from 0 to 10 decibels depending on existing conditions and changes in traffic patterns. Current noise levels in the service area are now low and the possible noise increases will not be harmful to the environment.

Groundwater Hydrology/Quality

Construction of a municipal sewage treatment facility capable of handling all wastewater produced by the anticipated increase in population to the year 2000 would reduce the number of individual septic tank systems installed for new housing developments and would replace some of these now in existence. Since septic systems tend to increase the total dissolved mineral content of groundwater and sometimes introduce bacteria, viruses, and degradable organic matter (M-9), a decrease in the number of septic systems installed would benefit overall groundwater quality. The magnitude of this impact is not readily measurable, but is probably small.

Expansion of the Reno-Sparks urban area may cause slight variations in the groundwater table. As discussed in Chapter 3, the unconsolidated alluvial deposits within the Truckee Meadows Valley contain most of the groundwater found within the basin. Storm drainage collection and increased acreage of impervious surface, will accompany urbanization, and contribute to the gradual decline in the groundwater table. Other factors associated with residential land use such as lawn watering may also contribute to water table fluctuations and offset decline.

Groundwater quality may be improved as agricultural operations decline through reducing the quantity of agricultural contaminants seeping into area soils. Water quality may also be affected by runoff components from an expanded roadway network. Runoff components could possibly include asbestos, oil and grease, rubber, deicing salts, ferrocyanide, sodium ferrocyanide, chromate, and phosphate.

Water Use and Downstream Flow Quantity

Water is a scarce resource throughout the State of Nevada, and is fundamentally important to the present and future well-being of the Reno-Sparks Metropolitan Area.

Natural hydrologic processes, including precipitation, evaporation, soil infiltration, runoff, and streamflow all affect the amount of water present within Truckee Meadows which is a subbasin of the Truckee River Basin and comprises approximately 200 square miles in and around the Reno-Sparks area. The Truckee River traverses Truckee Meadows and supplies much of the water consumed within the subbasin. Man's activities affect the amount of water consumed, thereby reducing the available water downstream. The principal impacts of consumption in Truckee Meadows and other subbasins of the Truckee River Basin affect the hydrology of Pyramid Lake, a terminal body of water receiving all natural flows from the Truckee River. The historical diversion of water upstream from Pyramid Lake has accelerated the decline in lake elevation (P-2). Therefore, the present and future water budgets within the entire Truckee River Basin will determine whether Pyramid Lake continues to diminish in volume.

Expansion of the Reno-Sparks JWPCP to 40 MGD will accommodate population growth within the Truckee Meadows Subbasin. Although the plant itself will not affect the amount of water reaching Pyramid Lake, some proposed plant alternatives call for the spray irrigation of sewage sludge and phosphorus supernatant at a remote site (Spanish Springs Valley). Such irrigation practices will consume water, thereby affecting the volumes of water reaching Pyramid Lake; the impacts of these practices are discussed under the impacts on related environs.

The growth in population and the accompanying increase in urban water consumption in Truckee Meadows are secondary impacts of wastewater treatment plant expansion. Both the primary and secondary impacts of plant expansion affect the water budget of the Truckee Meadows Subbasin, and therefore affect the overall Truckee River Basin water budget and its influence on the level of Pyramid Lake.

Projections for the Truckee Meadows water budget to the year 2000 must, of course, be based upon a number of assumptions regarding water use consumption rates and changes in land use. A detailed description of these assumptions and the results of projection analyses are presented in Appendix 5.

The present year (1975) and projected year (2000) estimates of the Truckee Meadows water budget are summarized in Table 6-B. Analysis has shown that the impact of the projected population growth and concomitant land use changes will

TABLE 6-B

TRUCKEE MEADOWS ESTIMATED WATER BUDGET

	1975 (acre-ft/yr)	2000 (acre-ft/yr)
Inflows to Truckee Meadows		
Surface water and imports	547,000	547,000
Groundwater	1,000	1,000
Precipitation	30,000	30,000
Total (rounded)	580,000	580,000
Outflows from Truckee Meadows		
Surface water	480,000	486,000
Exports	17,000	17,000
Groundwater	Minor	Minor
Consumption		
Irrigation	38,000	16,000
Phreatophytes	7,000	3,000
Urban	17,000	37,000
Miscellaneous	18,000	18,000
Subtotal on Consumption	80,000	74,000
Total (rounded)	580,000	580,000

probably have a minor beneficial impact on water use and water supply resulting in an estimated additional 6,000 acre-ft/yr supplementary flow to the Truckee River as it leaves Truckee Meadows. However, this projected additional flow represents approximately 1 percent change from 1975 flows and, in light of the assumptions used to derive this estimate and the necessarily broad confidence limits involved in the calculations, this change must be considered within prediction error.

A more significant result of this analysis is that no major impact on water use and supply, adverse or beneficial, is expected to occur as a secondary effect of plant expansion. Increased water demands for urban uses should be offset by the decreasing water needs of irrigated croplands as they are abandoned or taken over by urban development.

IMPACT AT REGIONAL SCALE - FACTORS REFLECTING PRIMARY PROJECT IMPACT

Surface Water Quality

The operation of the proposed plant and sewage projects will reduce the need for additional treatment facilities upstream to the Nevada-California state line and thereby eliminate potential sources of pollution within the service area including possible seepage into the surface waters by groundwater carrying pollutants from individual septic systems. The implication of this protection of water quality even upstream of the treatment plant should be emphasized. The water supply source for residents in the Truckee Meadows area is primarily taken from the river as it flows through Reno. Thus, a significant beneficial impact for the protection of public health and welfare results from the proposed action which extends the ability of the regional sewerage system to collect wastewater and then to provide treatment in accordance with NPDES requirements.

Projected land use changes will reduce the amount of irrigated cropland to approximately 30 percent of existing acreage by the year 2000 (A-1). Since agricultural return flows contribute significantly to the nutrient and total dissolved solids levels in surface waters in the Truckee Meadows area (V-1), the background levels of these pollutants will decrease as the land use of irrigated croplands changes.

Urban runoff, however, which will increase as agricultural lands are urbanized, will also increase the pollutant load in the Truckee River due to the transport of surface contaminants which occur in urban areas. EPA calculations for a hypothetical but typical U.S. city indicated that the pollution loads of street runoff during the first hour of a moderate to heavy rainfall event would greatly exceed that same city's untreated sanitary waste during the same period. Pollutants associated with street runoff include BOD, asbestos, oil and grease, rubber, deicing salts, ferrocyanide, sodium ferrocyanide, chromate, and phosphate. These represent different parameters than previously associated with agricultural return flows from irrigated lands. This difference in type of pollutants and the obvious difficulty in predicting the runoff characteristics of urban areas yet undesigned, makes comparative analysis of relative impact of each land use impossible. It can be stated that the beneficial impacts of reducing agricultural runoff will be offset, to some degree, by the projected adverse effects of urban runoff.

Surface water quality impacts on the Truckee River below the treatment plant and on Pyramid Lake are directly associated with the proposed treatment plant improvement. As mandated by the NPDES permit, improvement in water quality (phosphorous loadings, in particular), is a primary reason for upgrading of the treatment process and the related expenditure of public funds. Downstream water quality implications are discussed in this chapter under the heading "Impacts on the Related Environs of Treatment Plant Alternatives".

IMPACTS AT REGIONAL SCALE - FACTORS REFLECTING SECONDARY PROJECT IMPACTS

Demographics

- Future Population Accommodated by the Proposed Action

  Chapter 4 presented a variety of area-wide population forecasts made by public agencies and private firms as of 1975. Since mid-1975, the Regional Planning Commission has been in the process of developing an updated County Land Use Plan; as part of this effort, the area is being analyzed in terms of suitability for and constraints on urbanization. This analysis, when completed, will provide

a new base of information for a refined population forecast. However, since this data is not yet available, previous forecasts are used in this report. The design population of the proposed Reno-Sparks JWPCP is 253,700 with an additional allowance of 42,475 for the summer tourist peak. Population forecast data displayed in Figure 4-5 shows that this forecast, 6, is in the middle of a broad spectrum of projections.

A recently published environmental study for extension of Route 395 (F-3) used a 1995 population range of 200,000 to 250,000, which is the current "working forecast" in use by the State Division of Highways in their continuing Truckee Meadows Urban Transportation Study (TMUTS). The high figure corresponds well with the resident-element of the JWPCP facilities plan (K-1) forecast of 253,705.

If the project is built as proposed, population growth in the Truckee Meadows-Lawton-Verdi area can be expected to occur, approximately as forecasted. If the no project alternative, or phosphorous removal only (no increase in capacity), is implemented, population growth (permanent residents) can be expected to dramatically diminish.

Current and forecasted distribution of population is shown in Table 6-C. For each sewer service zone (W-5), estimated 1973 population, forecasted year 2000 population and percentage distribution for each is shown. An analysis of existing and forecasted population distribution prepared for the TMUTS under both the 1964 (H-4) and 1973 (H-6) Traffic Analysis Zone (TAZ) systems shows, in general, a consistent distribution with that shown in Figure 4-5. The data shows absolute growth in population in all areas; the greatest growth is forecasted for the entire southeast and southwest Reno areas, Sun Valley and the Lawton-Verdi corridor west of Lawton. Many of the more urbanized areas, such as central Reno, northwest and northeast Reno, east and west Reno, as would be expected, are projected to grow less in absolute and relative terms than other areas.

The planned distribution of land use will be known when the Regional Planning Commission completes its Regional Land Use Plan. The distribution of population

TABLE 6-C

DISTRIBUTION OF POPULATION BY SEWER SERVICE ZONE

Sewer Zone	1973 People/Acre	1995(SEA) People/Acre	Percentage Increase
1	.44	.63	43.18
2	3.90	5.58	43.08
3	4.97	7.11	43.06
7	10.47	14.98	43.08
8	5.74	8.21	43.03
9	3.28	4.69	42.99
10	6.58	9.42	43.16
11	8.08	11.55	42.95
12	6.88	9.85	43.17
13	.06	.08	33.33
14	.90	1.28	42.22
15	5.02	7.18	43.03
16	.31	.44	41.94
17	.18	.25	38.89
18	.51	.73	43.14
19	.22	.32	45.45
20	.12	.17	41.67
21	6.13	8.78	43.23
22	.64	.92	43.75
23	1.42	2.03	42.96

and concomitant land use follows the availability of major facilities and dictates the placement of others, such as utilities, service facilities, schools and so on, the impacts on which are discussed elsewhere in this chapter.

If the no project or phosphorus removal only alternative is selected, the forecasted population distribution will likely not occur since total population growth itself will be markedly reduced and a major necessary facility will not be available to any more area than that which is now served by the sewage collection and treatment system.

A major effect, over time, of such a course would be residential development in the outlying areas, such as east Sparks, southeast and southwest Reno, at a low density, limited by the technical requirements for safe septic tank operation. Another option would be continued development of additional local sewage facilities. Either of these outcomes would run counter to public policy and efficient use of the planned sewage facility. If, at a later date, the treatment plant were expanded, an inefficient and awkward conversion to regional sewage facilities, combined with a probable "turnover" in land use to a more dense form of urbanization, would occur. Under no project, urbanization would not benefit from the control implicit in the planned installation of major public facilities. Public agency integrated system-wide planning and land use policy implementation would be substantially impaired.

- Housing

An important secondary effect of population growth is the demand for housing. WCOG has forecasted over the next decade, a need for 1,839 housing units annually (W-7).

However, significant forces within the total housing and land market are having their effect on various segments of the population. A significant proportion of new family-home buyers do not have incomes sufficient to afford housing at its current costs, as detailed in Chapter 4. This effect is concentrated in certain demographic sectors: the elderly, minorities and young marrieds. These groups are caught in

an economic squeeze for housing which will be aggravated in the future, though differently under the project and no project alternatives. If the project is built as proposed, population and economic growth in the area will increase land values over time to the point that land in the central areas will be converted to higher density uses; this evolution will displace residents in sections normally containing older and less expensive housing. These sectors contain a relatively high proportion of economically disadvantaged people who benefit from being located within easy access to downtown and transit in relatively inexpensive housing. As these areas are "turned over" to more intense land uses, displacing residents, they will likely be forced to seek more expensive housing at a greater distance from travel destinations. Thus the affected residents' housing costs, travel expense and convenience may be adversely affected.

If the no project alternative is selected, and population continues to increase to any extent, the demand for housing may exceed the supply, forcing the price of housing in all areas to increase. This will have a similar adverse effect on the economically disadvantaged sectors of the resident population.

- Economics and Employment

The relationship among the economic system, employment, housing and population, is portrayed statistically in data presented in Chapter 4. Total forecasted employment for Washoe County is shown in Figure 4-15; distribution of employment among industrial classifications to the year 2000 is shown in Figure 4-14 and in Table 4-N for the county and in Figure 4-13 and Table 4-M for Nevada. The forecasted distribution continues the trend evident over the past 35 years - reduced influence of agriculture and mining and a continued increase in the trade, transporation, service and government sectors.

As shown in Table 6-D, by the year 2000, manufacturing, transportation and finance will continue at a slightly greater percent of the work force in Washoe County than the state as a whole. The trade sector is forecasted to remain about 22 percent of the work force in Washoe County but will decline as a percentage of the state labor force, from about 20 to 16 percent. On

TABLE 6-D

PERCENT DISTRIBUTION AND TOTAL EMPLOYMENT
WASHOE COUNTY AND STATE OF NEVADA

	Washoe County		State of Nevada	
	1975	2000	1975	2000
Agriculture	--	.5	1.5	.9
Mining	.5	.3	1.5	.8
Construction	6.8	5.9	5.7	5.8
Manufacturing	5.9	5.8	4.3	4.7
Transportation	7.6	8.2	6.1	7.1
Communication				
Public utilities				
Trade	22.7	21.9	19.6	15.7
Service	33.7	35.2	40.5	34.1
Finance	5.1	6.8	4.0	5.2
Government and unreported	17.7	15.4	16.8	25.7
	100.0%	100.0%	100.0%	100.0%
Total employment[a]	77,900	114,800	260,000	403,600

NOTES: (a) Total employment increase between 1975 and 2,000 equals 47% for Washoe County and 55% for State of Nevada.

Source: Tables 4-M and 4-N (Chapter 4)

the other hand the government sector in the county labor force will decline slightly to about 15 percent at year 2000 while this sector will increase from 17 to 26 percent for the state.

Forecasts are based on assumptions, which may change. Therefore the forecasts, particularly for 25 years in the future, should be viewed with appropriate caution as representative of future conditions. The impact of unexpected exogenous events, such as shift in government spending, taxation policy or dramatic development for decline in industries, must be recognized for their potential to substantially alter the outcome of forecasted events.

If the project is built as proposed, economic and employment growth in the order of magnitude of that forecasted in Chapter 4 is likely to occur. Included in this growth are several specific proposals for hotel-casino complexes and a recently completed gaming complex in downtown Reno.

In 1970, total earnings in the Reno SMSA (Washoe County) amounted to 427 million dollars. By 1990, assuming the forecasted growth occurs, total earnings will amount to nearly 1.6 billion dollars and by the year 2000, nearly 1.8 billion (C-7).

If the no project alternative is selected, population and economic growth will slow to a fraction of that forecasted in Chapter 4 with probable attendant significant tertiary effects throughout the Washoe County economy. The construction-related industries would be among the first to decline, followed by service industries which are dependent on expenditure of income by more basic industries. Little or no expansion in the work force over current levels could take place and a decline is possible under these conditions.

Land Use and Urbanization

The proposed action affects two subareas within the WCOG Sewer Service Area: the West Reno-Lawton-Verdi area, extending from the western Reno city limit west through Lawton to Verdi; and the Metropolitan Reno-Sparks-Truckee Meadows area, including the incorporated areas of the Cities of

Reno and Sparks, Truckee Meadows, and Sun Valley. The second subarea is nearly co-terminus with the Sierra Pacific Power Company Water Service Area. The Truckee Meadows area approximates the Reno-Sparks Urban SMSA. Lemmon Valley, Stead, and Spanish Springs are not considered in this discussion, as they are outside the service boundary (see Figure 4-1).

As pointed out in Chapter 4, general plan revisions are now in progress. Consequently, the projections in this section as to land utilization are made to quantify the impacts of the facilities plans as written and are not intended as predictions of a new general plan configuration. The facilities plans are designed for a year 2000 population of 296,000 including 253,500 permanent residents and 42,500 tourists (K-1).

- Metropolitan Truckee Meadows (Truckee Meadows)

  Given the SEA facilities plan population for the west Reno-Lawton-Verdi areas of 51,500 in the year 2000, the Truckee Meadows share of the year 2000 WCOG sewer service region population is 202,000 permanent residents. The net population increase over the 1976 to 2000 period for Truckee Meadows is 50,500 persons (202,000 less the present Reno-Sparks-Truckee Meadows population of 151,500).

  Based on the Regional Planning Commission's estimate of 3.3 persons per dwelling unit (S-1), the 50,500 population translates into 15,305 net new dwelling units (assuming a zero vacancy rate and no loss of existing dwelling units). Converted into acreage devoted solely to residential use, and based on a typical single-family density of 4.5 dwelling units per acre, this net population increase requires 3,400 acres (5.3 square miles) of new residential land in the Truckee Meadows area.

  If ancillary development generated by the 50,500 population increase were allocated according to the land use distribution recommended by the Reno General Plan (R-4), such that acreage in residential use amounts to 51.3 percent of total developed area, the net population would require a total developed area of 6,600 acres (10.3 square miles). The land use components and resulting acreages are as follows:

residential--3,400 acres; commercial--485 acres; industrial--495 acres; community facility--1,025 acres; vacant or other--1,195 acres; total acreage--6,600 acres (see Table 6-E).

Given the 253,300 permanent resident population forecast and the population distribution within the sewer service region implied by the facilities plans, the 50,500 net increase represents an annual growth rate in Truckee Meadows of 765 new dwelling units per year. The population increase would require approximately 10 square miles of land to be converted to urban uses or 13 percent of the available supply of approximately 76 square miles of land capable of supporting development (H-3, R-3, R-6, R-7).

- West Reno-Lawton-Verdi (Lawton-Verdi)

A similar land use analysis can be applied to the population forecast for the west Reno-Lawton-Verdi area. The existing population of the Lawton-Verdi area is 3,500 persons (S-1). SEA also estimates 79,000 persons as "the ultimate population the area can sustain". This ultimate population is comprised of 51,000 persons from the Reno city limits to Lawton, and a 28,000 population in the corridor between Lawton and Verdi. The ultimate population may be expected to occur by the year 2020. According to SEA (S-18), 65 percent of this ultimate development is expected to occur by year 2000, or 20 years from completion of construction; hence the Lawton-Verdi year 2000 population estimate is 51,500.

The magnitude of the 51,500 population prediction deserves special comment. Over a 20-year period the Lawton-Verdi area will experience a net population increase of 48,000 persons. Reno's 1975 population was 88,000; comparatively the Reno-Lawton-Verdi estimate net increase is equal to 54.5 percent of Reno's 1975 total. The 48,000 net increase amounts to an annual growth rate of 2,400 persons per year. A forecast for Washoe County's growth for the 10-year period 1975 to 1985 estimates a net permanent resident population increase of 59,500 (S-1) or 5,950 persons per year. Relative to the county's 5,950 per year estimate, 40.3 percent of Washoe County's yearly growth will occur in the Lawton-Verdi area. Further, given the sewer service area net population increase

TABLE 6-E

METROPOLITAN TRUCKEE MEADOWS GENERATED LAND DEVELOPMENT - USAGE DISTRIBUTION ACCORDING TO RENO GENERAL PLAN

Land Use	% of Total	Required No. of Acres
Residential	51.3	3,400
Commercial	7.3	485
Industrial	7.5	495
Community facility	15.5	1,025
Vacant or other	18.0	1,195
TOTAL	99.6	6,600 (10.3 sq. mi.)

of 98,500 by the year 2000, 49 percent of this increase would be expected to locate in the Lawton-Verdi area.

The 51,500 year 2000 population forecast implies significant land use impacts for the Lawton-Verdi area. Using the Regional Planning Commission household size estimate, the 48,000 net population translates into 14,500 net new dwelling units. At a typical single-family residential density of 4.5 dwelling units per acre, the Lawton-Verdi population growth requires 3,220 acres (5.0 square miles) of land devoted solely to residential use. In addition, the 48,000 new population would generate ancillary development of 3,030 acres (4.8 square miles), for a total of 9.8 square miles. The specific land uses and acreage requirements are as follows: residential--3,220; commercial--460 acres; industrial--470 acres; community facility--970 acres; vacant or other--1,130 acres; total acreage--6,250 acres.

National patterns of actual land usage have been tabulated, based on averaged data of several American cities (M-5). By comparison, the Reno General Plan distribution recommends less auxiliary development per dwelling unit than does nationally observed usage. If the Lawton-Verdi area development were according to this national pattern, the 48,000 net population increase translates into 8,260 acres (12.9 square miles) of total new development.

The foregoing analysis assumes a residential density of 4.5 dwelling units per acre. If, however, the west Reno-Lawton-Verdi area were developed at a more typical suburban density of 3 dwelling units per acre, the urbanizing impacts would be more pronounced. Under this assumption, the 14,500 net new dwelling units would require 4,830 acres (7.5 square miles) devoted solely to residential use. Based on the Reno General Plan land usage distribution, at the 3 D.U./acre density the total acreage which would experience development is 7,860 total acres (12.3 square miles). If the usage distribution follows the national pattern, ancillary development at a 3 D.U./acre density requires 9,875 total acres (15.4 square miles).

All of the discussed Lawton-Verdi generated development results are shown in Table 6-F. This table represents both land usage distributions and acreage

TABLE 6-F

WEST RENO-LAWTON-VERDI GENERATED LAND DEVELOPMENT

Land Use	Reno General Plan (% of total)	National Pattern (% of total)	Required Acreage: Density = 4.5 D.U./Acre, Reno General Plan (acres)	Required Acreage: Density = 4.5 D.U./Acre, National Pattern (acres)	Required Acreage: Density = 3 D.U./Acre[a], Reno General Plan (acres)	Required Acreage: Density = 3 D.U./Acre[a], National Pattern (acres)
	(Usage Distribution (@ 4.5 D.U./acre)					
Residential	51.3	39.0	3,220	3,220	4,830	4,830
Commercial	7.3	10.9	460	900	460	900
Industrial	7.5	4.8	470	400	470	400
Community facility/ other public	15.5	25.7	970	2,120	970	2,120
Vacant or other/ road and highway	18.0	19.7	1,130	1,625	1,130	1,625
TOTAL	99.6	100.1	6,250 (9.8 mi.^{2})	8,260 (12.0 mi.^{2})	7,860 (12.3 mi.^{2})	9,875 (15.4 mi.^{2})
Generated land development as a percent of present City of Reno urbanized area			38.6%	51.1%	48.6%	60.9%

NOTES: (a) The conversion of land area to non-residential urban uses is determined by magnitude of population, and not by acreage in residential use. Acreages devoted to non-residential urban uses (commercial, industrial, etc.) are computed according to the relevant population at 4.5 D.U./acre, and are independent of changes in residential density.

Source: (R-4)

totals for the two residential density situations. For comparison purposes, the Lawton-Verdi generated land development is measured in relation to the present Reno urbanized land area. The developed area necessary to service the Lawton-Verdi year 2000 net population ranges from 38.6 to 60.9 percent of Reno's present urbanized area of 16,170 acres (25.3 square miles).

If forecasted urbanization occurs in the Lawton-Verdi area, then from 9.8 to 12.9 square miles of land area must be developed under a 4.5 D.U./acre density or from 12.3 to 15.4 square miles, assuming 3 D.U./acre. Potentially developable land within the Lawton-Verdi area is approximately 26 square miles within Lawton-Verdi (R-25). Thus, by the year 2000, from 38 to 59 percent of the present stock of potentially developable land will have been converted to urban uses.

According to this land use analysis method, and assuming the more favorable 4.5 D.U./acre residential density, the year 2020 net population of 75,500 persons will have consumed from 56 to 75 percent of all lands within the area potentially suitable for development. At the 3 D.U./acre density, and following the Reno General Plan usage distribution, by year 2020, 71 percent of the existing stock of potentially developable land within the Lawton-Verdi area will have been developed. Under the national pattern distribution, by year 2020 development would represent 8 percent of the present 26 square mile stock.

In summary, the Lawton-Verdi Sewer facility plan anticipates large-scale urbanization in the Lawton-Verdi area, which implies limiting the growth potential of Reno-Sparks-Truckee Meadows. With an existing population of 3,500 persons, the Lawton-Verdi area has, at present, an undeveloped infrastructure for managing the facilities-directed growth.

The servicing of a year 2000 total population of 51,500 requires the provision of: law enforcement, fire protection, schools, solid waste disposal and other public safety, health, and education facilities, parks, libraries, and various other community cultural and recreation needs. Local government must be expanded to administer a wide range of essential public services.

These services and facilities are presently not available in this area and therefore must be created. As an indicator of the level of service which would be demanded, a city 58 percent as large as Reno will have to be built in the Lawton-Verdi area.

Conversely, the Metropolitan Reno-Sparks-Truckee Meadows Area, with a present population of 151,500 and an existing urban core infrastructure, is comparately more capable of managing growth and supplying public services.

The effect of the facility plan (S-1, S-18) population distribution is that 49 percent of the total forecasted year 2000 population growth will occur in Lawton-Verdi, which area includes 25 percent of the WCOG Sewer Service Region's developable land supply. Truckee Meadows containing 75 percent of the region's developable land stock will absorb 51 percent of the total forecasted population growth.

While the rapid growth for the Lawton-Verdi area as predicted in the facilities plan might be questioned, the ultimate population set forth for the service area is reasonable and consistent with historic growth patterns and land uses.

Thus far the discussion has concerned the land use impacts which would result from a project program of treatment plant expansion and construction of both the Cross-Town and Lawton-Verdi Interceptors. Also requiring consideration is the alternative case of treatment plant and Cross-Town Interceptor improvements, without construction of the Lawton-Verdi Interceptor. Lacking the prerequisite service capability, the Lawton-Verdi population would remain relatively small. Certainly growth on the scale of the 48,000 forecasted increase could not be accommodated. As the year 2000 population target of 296,000 is a function of treatment plant expansion, and unrelated to interceptor capacities and/or routes, then growth otherwise expected in Lawton-Verdi would in this case likely occur in Truckee Meadows, where sewer service would be available. The Metropolitan Reno-Sparks-Truckee Meadows Area would absorb nearly all of the year 2000 sewer service region net population increase of 98,500. Under the same assumptions as used before,

total new development (at 4.5 D.U./acre) would require the conversion to urban uses of 12,880 acres (20.1 square miles), amounting to 26 percent of the available supply of approximately 76 square miles of developable land.

If no treatment expansion/sewer construction is authorized, urban growth throughout the WCOG Sewer Service Region would be diminished. As the sewer's treatment system is presently at capacity, any growth which would occur would be serviced by septic tanks or by individual treatment systems most probably at a significantly lower density than would otherwise occur.

Urban Systems

- Transportation

Increased population growth potential in the Reno-Lawton-Verdi area resulting from the project will have the associated impact of increased vehicular travel in these areas.

Since it has been determined that the project will essentially not affect adopted land use plans, except for the Lawton-Verdi area, transportation facilities and planning should thus basically follow the continuing guidelines of the TMUTS. In the continuing transportation planning efforts of the state and local agencies, however, special consideration should be given to analyzing the adequacy of existing and proposed facilities in the east-west corridor between Reno and Verdi for accommodating potential increase in travel demand.

The 79,000 population forecast for total development of the Lawton-Verdi area will have significant transportation impacts within the Reno-Lawton-Verdi corridor. Although the TMUTS projections were for 1990, the difference of approximately 68,000 persons between the two projections will result in an estimated increase of 193,000 daily residential-oriented vehicle trips in this area. Even further additional trips will be generated, depending on the magnitude of other land uses accompanying this increase in population. Three possible distributions of land usage for total development are given in Table 6-F.

To assess the overall magnitude of the traffic impact from the potential population growth, the land usage distribution shown in Table 6-F, from the Reno General Plan, was used to develop traffic projections in the Reno-Verdi area for the year 2000. Table 6-G compares the projected data for 2000 to that previously developed for 1990. For this comparison, it was assumed that 65 percent of the ultimate population, or approximately 51,500 persons, would reside in the area by the year 2000 (S-18). The 400,000 trip ends are the total that each land use might generate, based on the trip generation factors described and itemized in Table 6-G.

Since trip productions and attractions have not been developed for this land usage distribution, the distribution of the trips cannot be defined. However, it can be assumed that many of the residential and commercial trips will be shopping trips within the area. Also, some of the industrial trips will be internal to the area, although many will likely be to and from other areas of Metropolitan Reno.

Of the 51,500 population prediction, at year 2000 33,500 is estimated to occur in the west Reno-Lawton area and 18,000 in the area between Lawton and Verdi. The greatest impact within the Reno-Verdi corridor is likely to be more specifically between Verdi and Lawton. No widening or reconstriction plans are indicated in the TMUTS for either of the two major facilities in this corridor - U.S. 40 and I-80. From the Lawton area, one new and two widened major facilities are proposed by 1990. To accommodate the predominately Reno-oriented travel desires, future planning should provide for extension of future local east-west arterials into the Verdi area.

Based on data obtained from the Nevada State Highway Department, a relation of population-derived travel increase in the Reno-Verdi area to travel in the total urban area was developed as follows. From 1974 traffic data, a daily average of 2.34 million vehicle-miles of travel was calculated for the entire road system in Washoe County. Travel forecasts have been developed for two different 1995 population projections; for a 200,000 population,

TABLE 6-G

LAWTON-VERDI AREA VEHICLE GENERATION

	1964 Study Data	1990 Projections[a]	2000 Projections
Population	2,573	11,385	51,500
Dwelling Units	785	4,627	15,560
Commercial Acreage (Gross)	-	112	460
Industrial Acreage (Gross)	-	67	470
Community Facilities Other Acreage (Gross)	-	-	2,100
Total Trip Ends	10,445	45,860	400,000[b]

NOTES: [a] Data from Truckee Meadows Area Urban Transportation Study.
[b] Assumed trip generation factors:

Residential	10 TE/DU
Commercial	500 TE/Net Ac
Industrial	79 TE/Net AC
Community	10 TE/Net AC

(Gross Acres were reduced by 15% to obtain net acres).

Residential	155,000
Commercial	195,000
Industrial	32,000
Community Facilities	18,000
Total	400,000

3.62 million vehicle-miles of daily travel are estimated; for a 250,000 population, the estimate is 4.66 million vehicle-miles.

Other modes of transportation will expand with overall growth and growth in the Lawton-Verdi area. As the population density in the Lawton-Verdi area increases and a demand is created, it may become desirable to extend bus service to this area. Increases in rail transportation are likely to be related more to freight than passenger service. Projects are planned for the near future that will expand and rehabilitate the Reno International Airport to accommodate expected increases in air passengers and cargo (R-9).

Selection of the no project alternative for the JWPCP, if accompanied by a moritorium on sewer connections, will reduce urbanization to such an extent that trips would increase very little - only in proportion to the development which might be permitted to utilize septic tanks or local treatment plants. However the length of trip will undoubtedly lengthen as population increase is forced farther and farther away from the urban core.

If the no project alternative is selected for the Cross-Town or Lawton-Verdi Interceptor Sewers, traffic in these areas will grow only very slowly. However, traffic in other parts of Truckee Meadows would increase measurably over that forecasted for the project as proposed because urbanization would be redirected away from the northwest and west Reno and the Lawton-Verdi areas, probably to southwestern, southeastern and eastern Reno, as well as eastern Sparks.

- Solid Waste

Solid waste collection within the Truckee Meadows Basin is presently handled by several collection services, the largest of which is the B & L Disposal Company, franchised by the Cities of Reno and Sparks and Washoe County. All of these collection services deliver collected trash and garbage to a central transfer station operated within the city.

of Reno by the B & L Disposal Company. Large trucks are used to transfer solid wastes from this transfer station to a sanitary landfill located east of Vista near the Truckee River. Local operators estimate that this dump site will be adequate to serve the Reno-Sparks area for the next 200 years. Presently an estimated 2,800 tons of refuse is being delivered to the dump site each week. The population growth permitted by the completion of the proposed project will significantly increase the quantity of solid waste generated by the area. However, this increase is within the capacity of the present facility and solid waste disposal is not viewed as a significant impact.

- Other Sewage Treatment Facilities

Recommendations to insure effective wastewater treatment, of concepts as identified by the Federal Water Pollution Control Act Amendment of 1972, and the State of Nevada, Environmental Protection Services, have been made for the Truckee Meadows Region (W-1). The program for these recommendations encompasses the 1995 planning period for the regional treatment plant at Vista, and (most recommendations) include connection of tributary areas to this regional treatment system. Recommendations presented for existing and future interceptor zones are outlined below:

Spanish Springs Interceptor Extension
(proposed 1995 planning period)

- Service to East Sparks
- Service to Sun Valley
- Connection to JWPCP

Sparks Interceptor Extension
(proposed 1995 planning period)

- Service to Sparks
- Connection to JWPCP

North Reno Interceptor (existing connection to JWPCP)

- Retirement of KOA Campground Wastewater Treatment Plant
- Retirement of Panther Valley Wastewater Treatment Plant

North Truckee Meadows Interceptor (existing connection to JWPCP)

- Diversion of flow to Mill Street Interceptor from:

  1. Lawton-Keystone Area
  2. Mayberry-Idlewild Area
  3. West of Wells Area
  4. Skyline Area

- Extension of Mill Street Interceptor (existing connection to JWPCP)

Mill Street (Cross-Town) Interceptor Extension (proposed 1995 planning period)

- Extension to Verdi (Lawton-Verdi Interceptor)
- Retirement of River Inn Treatment Facility
- Relief of Overloaded North Truckee Meadows Interceptor

South Truckee Meadows Interceptor (existing connection to JWPCP)

- Service to Wheeler Reservoir Area
- Service to area northwest of airport
- Service to area southwest of airport
- Service to Hidden Valley Area
- Service to Virginia Longley Area
- Service to Dry Creek Area
- Service to Mount Rose Area
- Upgrade of CBD Wastewater Treatment Plant
- Retirement of Steamboat-Dorothy Towne Wastewater Treatment Plant

The course of action outlined above has been derived by local public agencies to safeguard public health and ecological systems from the hazards of contaminated ground and surface waters.

Should no project alternatives be selected, further urbanization would be curtailed and, in addition, public health would be endangered by use of septic tanks and continued operation of subsurface waste disposal systems such as:

- Arrowhead Trailer Lodge
- Twin Lakes Drive Residential Development
- Zephyr Motel
- Mesa Park
- Mayberry Estates
- Juniper Terrace
- Truckee Park Mobile Homes
- Boomtown Truck Stop
- The Verdi industrial complex, trailer park and central urban area

The above facilities have the potential to endanger groundwater and lack secondary treatment techniques necessary to comply with discharge requirements established by State of Nevada Environmental Protection Services.

- Public Safety

Larger populations accommodated by the proposed expansion of the regional sewage treatment will necessitate increased public protection and health facilities and personnel. In accordance with the U.S. Deaprtment of Commerce, Bureau of the Census, such personnel have been aggregated into four groups: physicians, dentists and related practitioners; health workers; health service workers, and protective service workers (C-14).

The 1970 census of the Reno SMSA contains the number of employed persons in the aforementioned occupational groups. The number of persons in each group was then related to the approximate 1970 population of 121,068 to determine a resident population per occupation -

individual (people/O.I.). This ratio (assumed constant) was then applied to the maximum forecasted population of 296,000 persons served at 40 MGD treatment facility operation to yield year 2000 occupation-individual requirements shown in Table 6-H.

TABLE 6-H

PUBLIC SAFETY WORKERS

	1970 (people/O.I.)	1970 (20 MGD)	2000 (40 MGD)
Physicians, dentists, related practitioners	292./I	415 (no. of individuals)	1,015 (no. of individuals)
Health workers	120./I	1,013	2,477
Health service workers	141./I	859	2,100
Protective service workers	172./I	704	1,725

In a similar manner, health facilities and emergency services needs were extended to the year 2000. Data obtained from the Nevada State Health Department indicates that there is one bed available per 160 people, and one ambulance per 18,312 persons. If these ratios are maintained, the 296,000 capacity at 40 MGD plant operation would require 1,847 general hospital beds and 16 ambulances.

The impacts on public health resulting from the proposed expansion of the Reno-Sparks JWPCP should be viewed as significant secondary commitments necessary to maintain the present "quality of life" in the service area.

- Education

Expansion of the plant capacity wil accommodate growth that is expected to increase by 65 percent the present population within the next 25 years.

Urbanization of this magnitude will have a significant impact on the educational facilities needed in the Truckee Meadows area.

The study area is served by the Washoe County School District. The district presently provides education to approximately 31,000 students in the primary and secondary grade levels. The district has school facilities consisting of 1,353 classrooms and is staffed by 1,366 teachers and teaching personnel. These figures yield a student/teacher ratio and student/classroom ratio of approximately 23 students per each teacher and classroom with existing staff and facilities. The school district estimates the present cost of educational services to be approximately $1,200 per student per year. Approximately 65 percent of this expenditure is supplied by local tax assessments with the remaining 35 percent coming from state funding.

Expansion of the Reno-Sparks JWPCP will serve an area population of approximately 254,000 permanent residents by the year 2000. Analysis of this population forecast, assuming current family size, results in an estimated primary and secondary grade enrollment of nearly 51,150 students requiring educational service by that date. Assuming present levels of service are to be continued, an additional 888 teachers and 880 new classrooms will be required to meet the increase in enrollment. In addition, administrative personnel and facilities will be required.

While such expansion is substantial in the aggregate, the 25 year time span will permit orderly fiscal and financial planning. The degree of difficulty in financing the expansion will depend on many factors including rate of student increase, state and local share finance structure, and most important, the actual land use mix which forms the future tax base for the school system.

- Water Supply

The major water system in Washoe County is owned and maintained by Sierra Pacific Power Company and has the capacity to accommodate 300,000 to 350,000 people, utilizing current water rights and existing

and proposed facilities (I-2). This population capacity exceeds the capacity range of the proposed JWPCP expansion.

- Energy Supply

Population and economic activity forecasted in the year 2000, facilitated by the proposed project, will create a demand for additional power over that currently used by residential, commercial and industrial consumers. Sierra Pacific Power Company, the supplier of gas and electric power in the serivce area, has made forecasts of electric power supply and demand to 1985 (S-24). This forecast took into account historic relationships between energy demand and population and economic growth; it also examined the effects of the fuel shortage of 1973 to 1974 and future changes in fuel supply, availability and price mix. In addition, the forecast examined the impact of new technologies in energy generation and conservation. The power company expects total electrical energy demand to increase by 7.7 percent and peak load demand to increase by an average of 8.6 percent annually through 1985. Electrical demand distribution among Sierra Pacific Power Company customer groups is shown in Table 6-I. Electrical energy supply currently is derived from the sources as shown in Table 6-J.

The historic and forecasted relationship of electrical supply and demand is shown in Figure 6-1, which assumes the proposed North Valmy station is brought on line in two units in 1980 and 1983. Without these two units, the system capability would fall below the annual peak load in mid-1981. Although the Sierra Pacific Power Company has not forecasted supply and demand beyond 1985, it is possible that demand for electrical power could be more than double the projected 1985 level by the year 2000, assuming continual growth at the average of 8.6 percent expected over the next 10 years.

TABE 6-I

DISTRIBUTION OF FUTURE ELECTRICAL DEMAND

	Total Energy Demand (percent)	
	1974	1985[a]
Residential	30	29
Small C & I[b]	33	30
Large C & I[b]	19	21
Other	18	20
TOTAL	100	100

NOTES: [a] Estimated by Sierra Pacific Power Company (S-4, S-13, S-23)

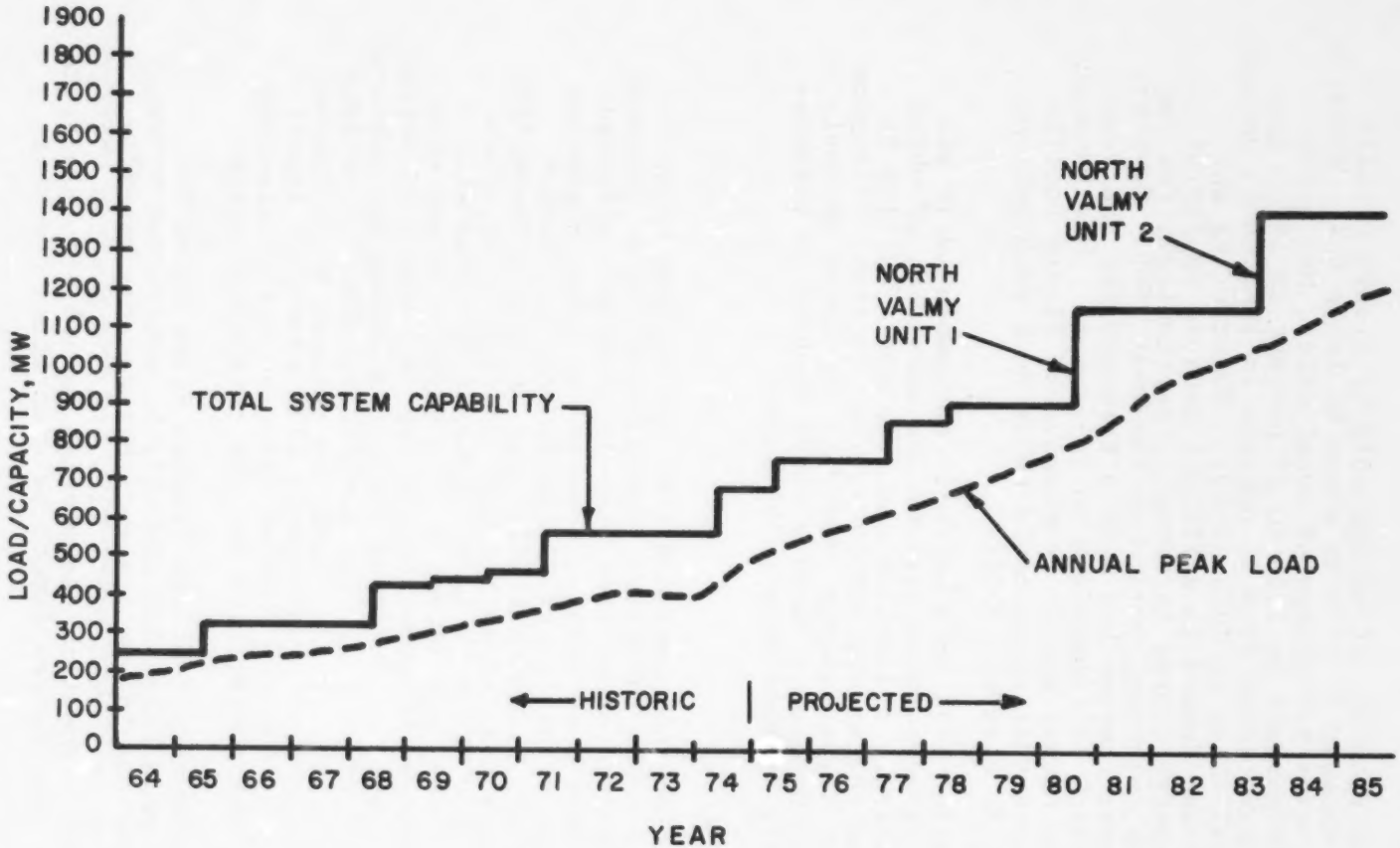
[b] C & I = Commercial and industrial

TABLE 6-J

ELECTRICAL SUPPLY SOURCES
(percent of total energy supply)

Power Source	1975	1985
Steam electric		
Oil/gas	62.5	33.4
Coal	--	35.8
Hydroelectric	1.6	.8
Peaking (gas turbines and diesel units)	11.8	6.3
Firm purchase commitments		
P.G.&E.	14.5	7.7
U.P.&L.	6.7	14.3
U.S.B.R.	2.9	1.7
TOTAL CAPABILITY	100.0% (746.2 MWe)	100.0% (1,396.2 MWe)

Source: (S-23)



PEAK LOAD AND SYSTEM CAPABILITY, 1964-1985

Source: (S-23)

Figure 6-1

The distribution of energy sold by Sierra Pacific Power Company in 1974 is shown in Table 6-K. Electric sales, as a percentage of total sales, has grown from 76 percent in 1965 to 79 percent in 1974; gas sales have grown from 11 percent in 1965 to 13 percent of total sales in 1974 (S-10). Forecasting gas supply and demand is difficult because supply of this energy source is tenuous, particularly for the extended planning period to the year 2000. However, the power company had made a forecast for the year 1985 which is summarized in Table 6-L. This forecast assumes normal winter temperatures; Sierra Pacific estimates that usage could be as much as 5 percent higher in a severe winter.

Population will only be fully accommodated if all the necessary urban systems are provided, of which the sanitary collection and treatment facility is one and the energy supply system, another. Planning to meet future energy demand is now being actively pursued by Sierra Pacific Power Company in response to their service responsibilities.

Flora and Fauna

As the population increases and land use changes occur to accommodate urban expansion, agricultural lands, natural desert and aquatic communities will be adversely affected in the newly developed areas. Much of the urban expansion is predicted to occur in agricultural areas of Truckee Meadows; however, planning studies are presently incomplete and therefore natural areas may also be subject to urban development. Reduction in these terrestrial areas will have a minor, long term impact on the vegetation and wild life of the Truckee Meadows area due to an overall reduction in available habitat. Outlying areas, including agricultural areas, are used by many of the wildlife species for various activities (See Chapter 3). Land use changes which remove open land habitat from productivity will adversely impact these species, by forcing them to find new territories and by increasing the competition for the remaining habitat.

The aquatic communities of the Truckee River below Reno-Sparks and Pyramid Lake will probably be unaffected by water quality changes due to the tradeoff between the benefits of reducing agricultural runoff flow and the adverse effects of urban runoff. However, the precise nature of the effects of these land use changes cannot be quantified due to a

TABLE 6-K

ELECTRIC AND GAS SALES, 1974
SIERRA PACIFIC POWER COMPANY

Total electric sales	2,309,036 MWH
Total gas sales	61,032,516 Therms
Electric customers	116,616
Gas customers	34,540
Revenues from electric sales	$55,682,000
Revenues from gas sales	$ 9,208,000

TABLE 6-L

DISTRIBUTION OF FUTURE GAS DEMAND

	Percent of Total Energy Demand	
	1975	1985
Residential	42%	40%
Commercial and industrial	56%	58%
Miscellaneous	2%	2%
TOTAL	100%	100%
(M Therms)	(71,676)	(37,922)

lack of site-specific water quality data for the existing agricultural return flows and the inability to predict the characteristics of street runoff from urban areas yet undesigned.

Projected changes in future water requirements indicate that the tradeoff between water used for irrigation and for urban purposes results in a sustained water budget. Consequently, the aquatic habitat is impacted by the removal of water-courses, ponds or lowlands for urban land use rather than by a reduction in the available water resource. Improvement in water quality downstream of the treatment plant, particularly in regard to phosphate loadings, will be generally beneficial to the aquatic biology.

Air Quality

Projected growth within the service area which is facilitated by the proposed expansion of the regional wastewater treatment facilities will result in changes in regional air quality. In the following sections, impacts of full growth accommodated by wastewater treatment plant expansion are estimated through a comparison of known 1975 emissions of particulates and 1973 emissions of carbon monoxide, hydrocarbons, nitrogen oxides, and sulfur dioxide with projections of emissions of these pollutants at 5 year intervals to the year 2000. A proportional technique of projecting future emissions was used, and the specific assumptions used to project emissions of each of the pollutants of interest are provided in the following pages. If NAAQS for a certain pollutant are currently being violated, and projections indicate emissions of that pollutant will increase in future years, it is assumed that population growth accommodated by wastewater treatment plant expansion will be accompanied by a continued violation of NAAQS and, therefore, adverse effects on air quality.

In a later section, air quality impacts associated with project completion/full growth are compared with no project/no growth.

- Suspended Particulates

  Particulates are composed of liquid or solid particles suspended in the air. They are known to produce a number of adverse health effects, including irritation of sensitive tissues such as in the respiratory system. They have a degrading effect on plant life and are primarily responsible for reduced visibility.

Data presented in the Environmental Setting, Chapter 2, indicates that total suspended particulate concentrations at Reno have exceeded annual geometric mean standards especially at locations in the vicinity of heavily traveled roadways. The area has been designated as an Air Quality Maintenance Area (AQMA) which indicates the severity of the problem. This information also indicates that an ambient level of particulates amounting to 1/3 to 1/2 of the urban particulate loading is a natural characteristic which reflects soils, climate and wind conditions indigenous to the area.

Major contributors to man-made particulate emissions in the Reno-Sparks areas include automobile operation, operation of other mobile sources, incineration, construction, sand and gravel pits, and other miscellaneous sources. Emissions in 1975 and projected emissions in 1980 and 1985 are presented in Figure 6-2. This data was obtained from the EPA report "Nevada Particulate Control Study for AQMA's, Task C Report, Emissions Inventory and Emissions Projections" (P-8). The most significant assumptions used in this report include:

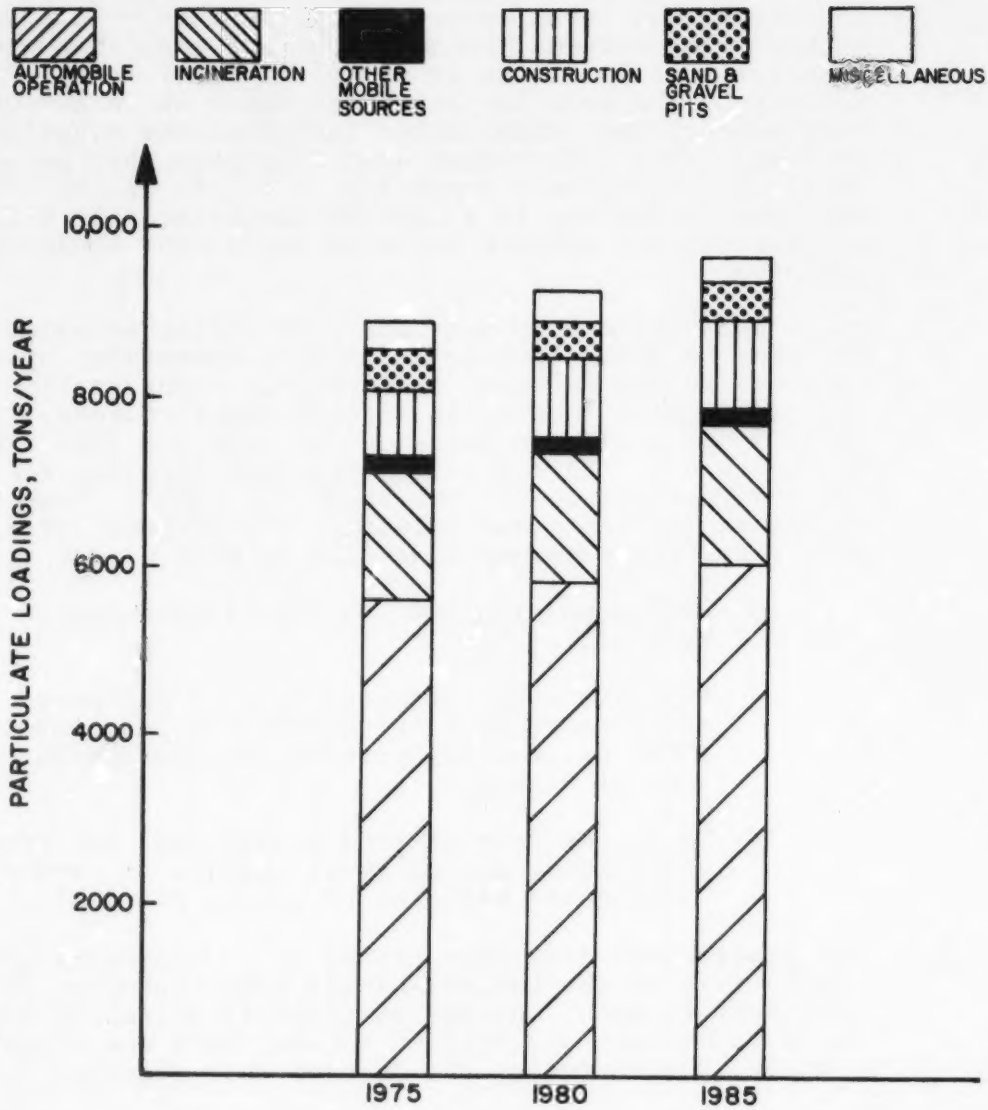
1) 1975 population of 135,520, increasing to 167,800 by 1985.

2) Fugitive dust emissions from normal paved streets are proportional to vehicular miles traveled (VMT) projections provided by the Nevada Department of Highways.

3) Emissions from unpaved roads, sand and gravel operations, agricultural operations, and street sanding are expected to remain constant.

EPA projections show that travel along unpaved roads will continue to be the largest single contributor to particulate emissions in Reno. Annual particulate emissions are expected to increase only slightly in future years and urbanization will decrease the extent of the unpaved road system.

An EPA study is currently underway to develop control strategies for major sources of suspended particulates. The Washoe County District Health Department will identify a range of control strategies from this study with an evaluation of each as to its probable effect in reducing emissions. The Department plans to present the control strategies to the Blue Ribbon Citizens Air Pollution Task Force Committee for determination of the social acceptability for implementation.



1975 PARTICULATE LOADINGS
AND PROJECTED LOADINGS - FULL GROWTH

Source: (P-8)

Figure 6-2

Regulations to implement control strategies will be drafted by the Department. Those measures over which the Department has authority will be adopted into their Air Pollution Control Regulations. Other mitigation measures beyond their authority will be presented by the Department to local jurisdictions for public hearings and necessary administrative actions for incorporation in county/municipal ordinances and codes.

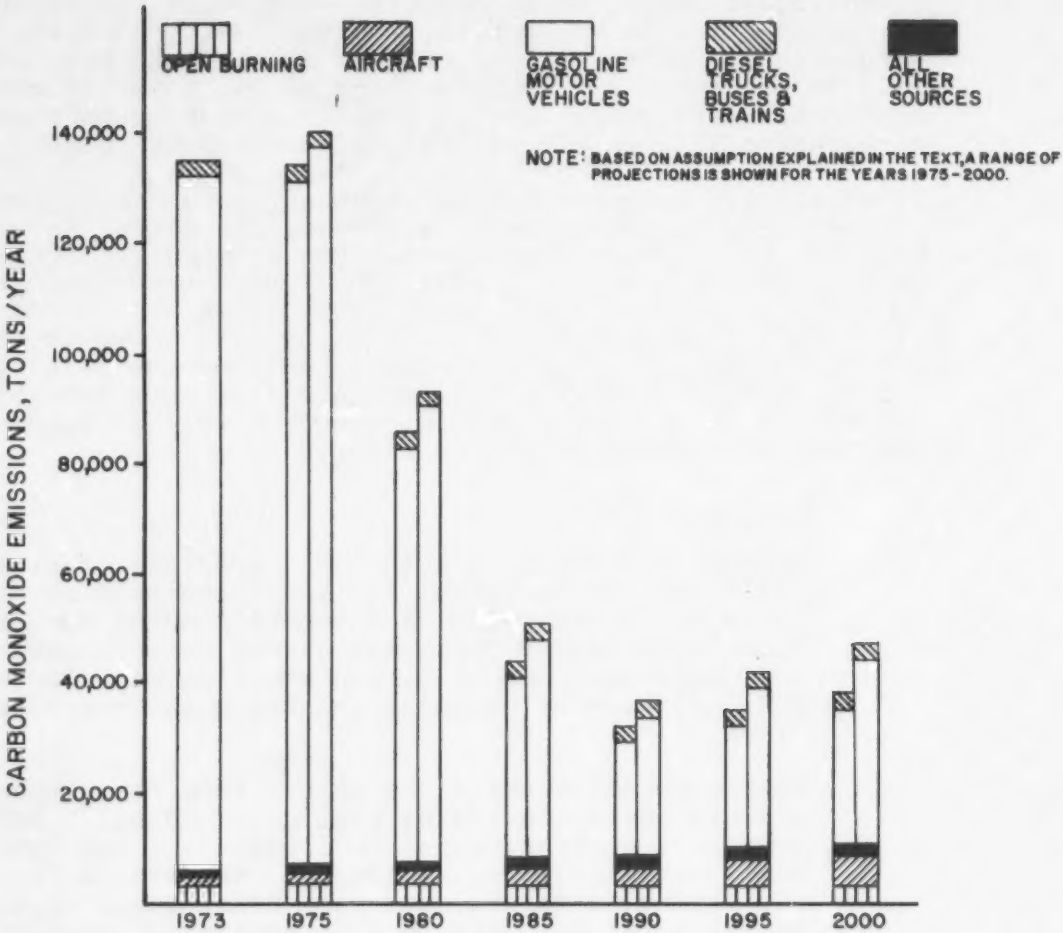
If mitigative measures are not adopted, population growth accommodated by expansion of wastewater treatment facilities will be accompanied by a continuation of NAAQS violations with regard to this pollutant. The TMBAQS used proportional modeling to predict that annual geometric mean concentrations will reach a maximum of 122.4 $\mu g/m^3$ by 1995. Due to the natural background, violations may continue even with mitigative measures. However, as urbanization adds impervious surfaces such as paving and buildings as well as lawns, etc., the natural background may be reduced.

- Carbon Monoxide

  Carbon monoxide is a colorless, odorless, tasteless gas which can be lethal in high concentrations (e.g., enclosed garages with an automobile motor running, homes with faulty furnaces). Long term exposure to low concentrations of carbon monoxide may also cause physical harm by damaging the brain and nerve cells (I-6).

  Carbon monoxide emissions result from the burning of organic fuels, including gas, coal and oil. Major source categories of this pollutant are gasoline motor vehicles, open burning, diesel trucks, buses and trains, aircraft, and many other small sources. As illustrated in Figure 6-3, automobile operation was responsible for the majority of carbon monoxide emissions in 1973. Emission projections are based on the following assumptions:

  1) Emission rates for light duty gasoline vehicles were projected for future years according to methods specified in "Compilation of Air Pollutant Emission Factors", Supplement No. 5, Second Edition (G-8). A temperature of 50°F was used as the average annual temperature and corrections were applied for this value. It was further assumed that 20 percent of the vehicles are operated from a cold start-up condition, 27



1973 CARBON MONOXIDE LOADINGS
AND PROJECTED LOADINGS - FULL GROWTH

Source: (R-31)

Figure 6-3

percent are operated in a hot start-up condition, and 53 percent are operated in a hot stabilized condition.

2) VMT projections were obtained from "Nevada Highway Department Status Report, 1975". A range of VMT projections was used, and for this reason a range of carbon monoxide emissions from autos, trucks and buses is projected.

3) Emissions from open burning were projected to increase at a rate equal to that predicted for the emissions of particulates from the same source, as projected in "Nevada Particulate Control Study for AQMA's, Task C Report, Emissions Inventory and Emissions Projections" (P-8).

4) Emissions from aircraft sources were projected to increase proportionally with projected annual aircraft operations forecasted in Master Plan Report (April 1976) for Reno International Airport and Reno/Stead Airport. The projections assume no forthcoming improvements in aircraft engine pollution control technology.

5) Carbon monoxide emissions for all other sources were assumed to increase at a rate proportional to increased population. Population projections used are an average of those obtained from studies by the Division of Water Resources, Regional Planning Commission, and University of Nevada.

At downtown sites within the study area, carbon monoxide concentrations frequently exceed standards. The TMBAQS predicts that NAAQS will not be obtained until 1981 (A-4). Various mitigative measures have the potential of advancing that attainment date somewhat. After 1981, it appears that the effects of increased population would be more than compensated for by increased use of late model cars with efficient pollution control devices. Results of proportional modeling alone in the TMBAQS indicate that the highest 1 hour concentrations in 1995 will be 11.4 ppm (35 ppm 1 hour NAAQS) while highest 8 hour concentrations will be 7.7 ppm (compared with the 9 ppm 8 hour NAAQS).

- Hydrocarbons

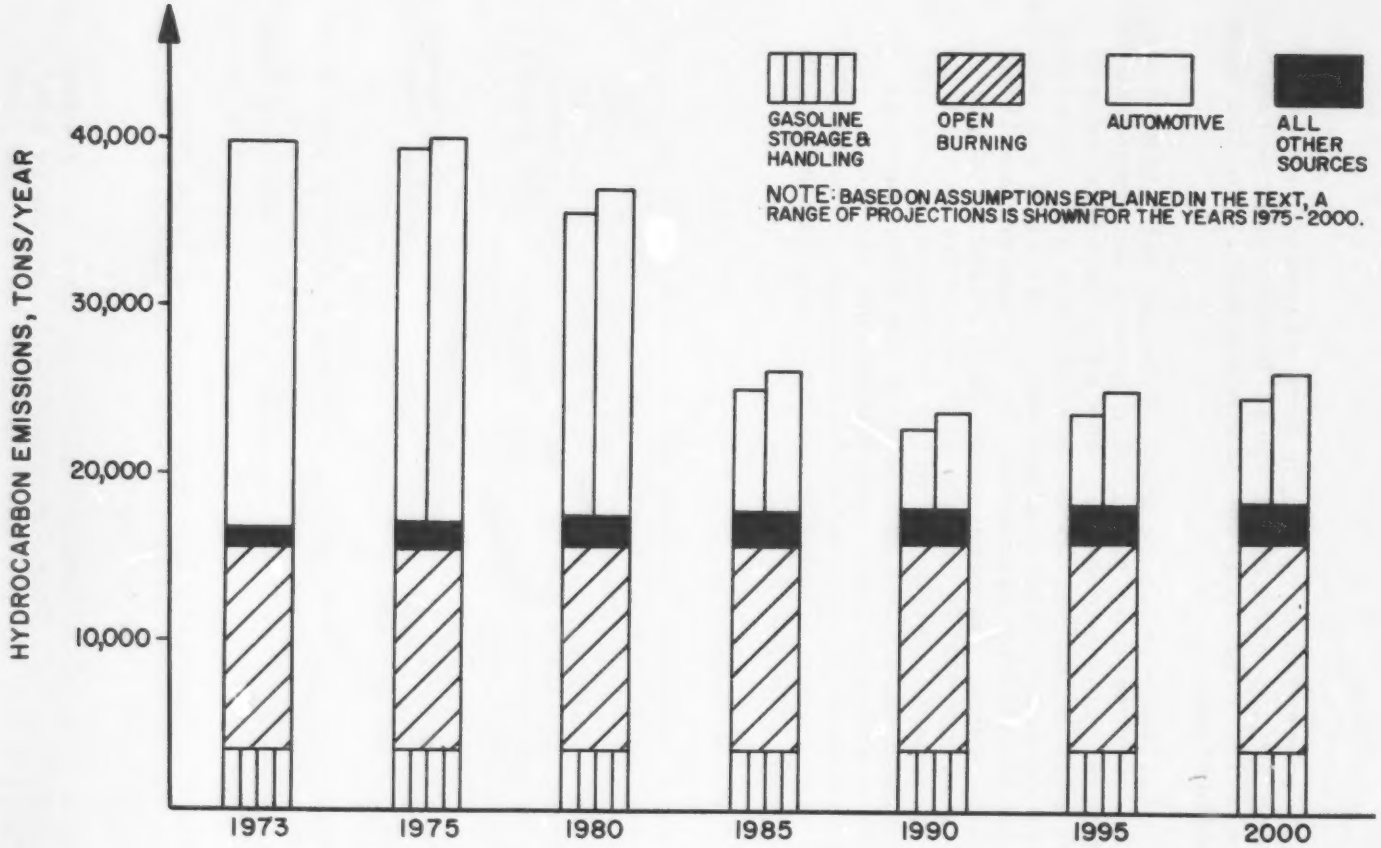
Hydrocarbons result from incomplete combustion and various natural processes. Although they have no known direct adverse health effects, hydrocarbons are thought to be one of the primary reactants in the production of photochemical smog (J-6). Four categories of emission sources were identified in the 1973 emission inventory, including: 1) gasoline motor vehicle operation; 2) open burning; 3) gasoline storage and handling; and 4) all other sources (most notably: diesel trucks, buses and trains; aircraft operation; kerosene storage and handling; and power generation).

Emissions in 1973 and projected emissions are graphically depicted in Figure 6-4. Emission rates of hydrocarbons from gasoline burning automobiles were projected using the methods described in the USEPA report "Compilation of Air Pollution Emission Factors - Supplement No. 5, 2nd Edition" (E-33). Assumptions concerning temperature and percentage of vehicles operating from cold- or hot- starts are the same as those used for carbon monoxide projections. Vehicular miles to be driven in Reno should increase according to a range of values obtained from "Nevada Highway Department Status Report, 1975".

Additional assumptions on which projections were based include the following:

1) Emissions of hydrocarbons from open burning will increase at the same modest rate as the increase in emissions of particulates from open burning sources as predicted in the PEDCo Report (P-8).

2) Emissions from gasoline storage and handling will remain constant, due to a counterbalance of increased emissions resulting from increased population and decreased emissions resulting from a consolidation of gasoline storage and distribution centers. Developing technology should result in a reduction of hydrocarbon emissions from these sources (D-10).



1973 HYDROCARBON EMISSIONS AND PRCJECTED LOADINGS - FULL GROWTH

Source: (R-31)

Figure 6-4

3) All other sources, which were responsible for less than 3 percent of total hydrocarbon emissions in 1973, will increase proportionately to increased population.

The projections indicate that although vehicular travel will be increased by population growth accommodated by wastewater plant expansion, the effects of increased travel will be offset by more efficient air pollution control devices. Hydrocarbon emissions from all sources will be reduced by approximately 38 percent by 1990. For this reason, no serious adverse effects on air quality attributable solely to hydrocarbon emissions will accompany wastewater plant expansion. However, hydrocarbon emissions are related to photochemical oxidant concentrations, and violations of NAAQS for photochemical oxidants, by a factor of up to two times the 1 hour allowable maximum, are projected in the TMBAQS through 1995 (A-4).

- Oxides of Nitrogen

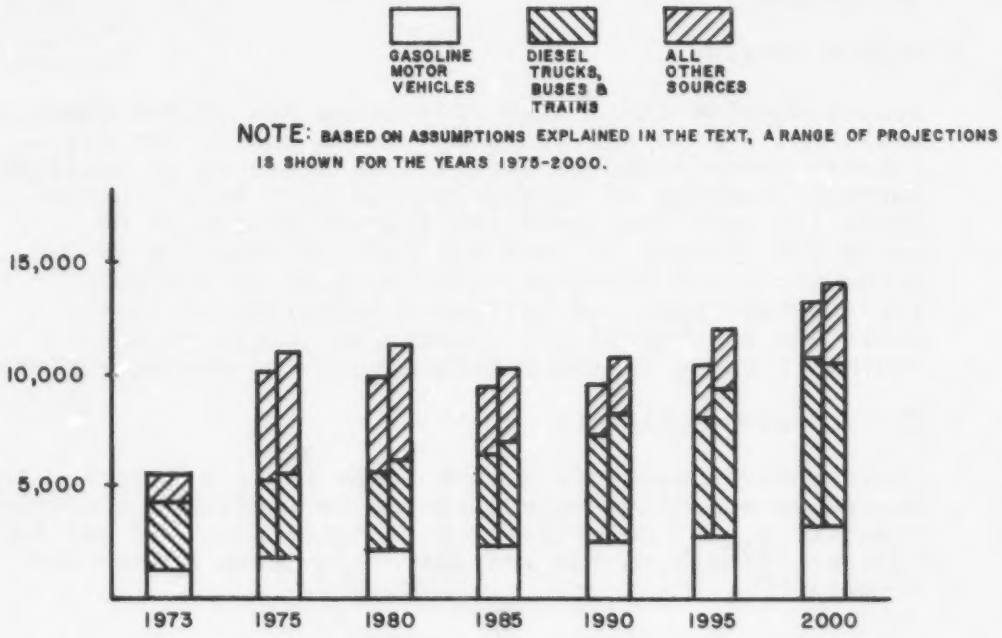
Oxides of nitrogen include nitric oxide (NO) which is not hazardous to health, and nitrogen dioxide (NO_2) which has a number of toxic effects at high concentrations. Nitrogen dioxide is a prime reactant in photochemical smog production. Significant sources of oxides of nitrogen include automobiles and diesel trucks, buses, and trains.

Emissions in 1975 and projected emissions are graphed in Figure 6-5. These projections are based on the following assumptions:

1) Emission rates of nitrogen oxides from automobiles and diesel-powered vehicles can be predicted according to methods described in the USEPA report (E-33).

2) VMT in Reno will increase according to a range of projections obtained from the "Nevada Highway Department Status Report, 1975".

3) Emissions of oxides of nitrogen from the source category "All Other Sources" will increase proportionally to increased population of the Reno-Sparks area.



1973 NITROGEN OXIDES LOADINGS AND
PROJECTED LOADINGS -
FULL GROWTH

Source: (R-31)

Figure 6-5

The percentage increase in nitrogen oxide emissions is expected to be as much as 50 percent by the year 2000 over 1973 levels due primarily to increases in transportation-related activities. The TMBAQS, using proportional modeling, predicts a maximum annual geometric mean concentration of NO_2 of 0.049 ppm in the year 1995, and emissions are expected to increase after 1995 (A-4). Therefore, violations of NAAQS for oxides of nitrogen can be expected to accompany full growth shortly after 1995 in the absence of mitigation.

- Sulfur Dioxide

Sulfur dioxide can damage vegetation and affect the health of humans and animals. It is one of the pollutants transformed to smog in the presence of sunlight. Current loadings of this pollutant into Reno's atmosphere are very low, with the primary source of SO_2 being the burning of fuel oil for home heating (H-11). Although future emissions are expected to increase, the adverse impact of increased emissions of this pollutant on overall air qualtiy is judged to be minimal because of the existing very low concentrations.

- Photochemical Oxidants

Photochemical oxidants are known to cause eye irrigation, damage to sensitive vegetation, a reduction in atmosphere visability, and deterioration of materials, and may have adverse effects on the respiratory systems of men and animals (F-13).

Oxidants (primarily ozone) concentrations at Reno are dependent on atmospheric chemical transformations including hydrocarbon, nitric oxide, sulfur dioxide and oxygen in the presence of sunlight, rather than direct emission of ozone from man-made sources. These transformations take approximately 1 hour to complete during which transport and dilution may occur.

Emissions of sulfur dioxide and nitrogen oxides are projected to increase in future years, while hydrocarbon emissions are projected to slightly decrease.

Violations of NAAQS for photochemical oxidants have occurred quite frequently in recent years, and the TMBAQS used the DIFKIN Simulation Model to predict that 1 hour concentrations as much as twice the allowable maximum will occur through 1995 (A-4).

- Variables that Could Influence Air Quality Impacts

The judgments concerning secondary impacts on air quality resulting from growth accommodated by wastewater treatment plant expansion are based on numerous assumptions which, in future years, may prove imprecise. The following variables may be important in altering the projected air quality impacts.

1) Population Growth - As discussed in Chapter 4, projections are based on full growth to 254,000 by the year 2000. Air quality modeling done under contract to the State of Nevada Department of Highways assumed growth to 250,000 by 1995. Alternatively, modeling done assuming a population of 200,000 by 1995 resulted in predicted concentrations of carbon monoxide approximately 10 percent lower than with full growth.

2) Industrial Expansion - Projected air pollutant loadings and their impact on air quality assumed no introduction of significant new industrial sources of air pollution. Large-scale industral expansion involving significant air pollution sources would have a serious adverse effect on air quality.

3) Vehicular Miles Traveled - The range of values shown in some emission projections for vehicular travel is based on estimates of 3.62 to 4.66 million miles per day to be driven in the study area in 1995. Emission projections would have to be adjusted if 1995 traffic loads were not within that range.

4) Existence and Efficiency of Automobile Pollution Control Devices - Projections were made assuming that post-1977 cars will be equipped with catalytic converters. It was also assumed that all cars equipped with anti-pollution control devices will be properly maintained, and the control devices properly installed. Recent evidence shows that this may not always be the case (S-30).

5) Mitigation - Emission projections were made assuming that no new local mitigative plans or measures will be taken to reduce air pollution sources.

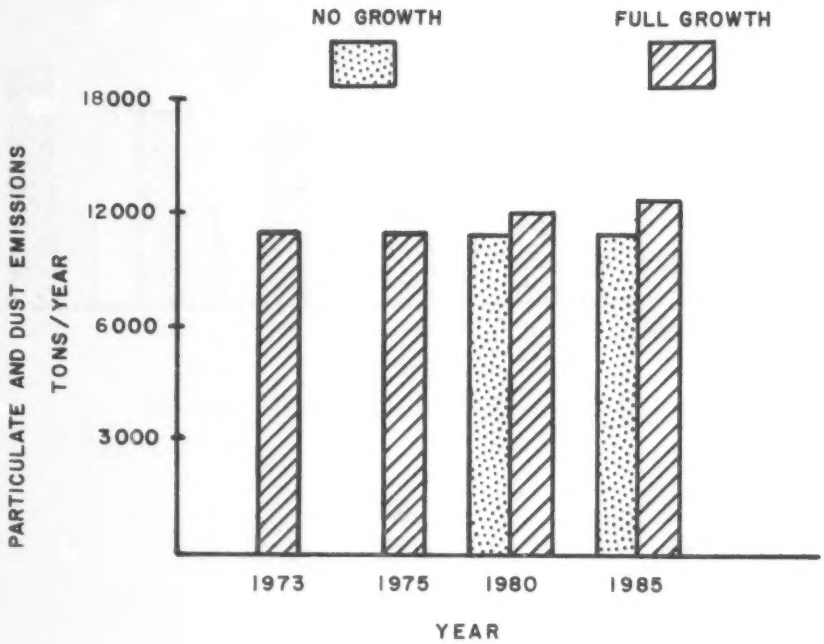
- Comparison of Air Quality Impacts - Project and No Project

The severity of the impact on air quality maintenance in the service area is directly related to the growth of population. The range of air pollutant emissions associated with no project/no growth and project/full growth is illustrated in Figures 6-6 through 6-9. The following assumptions were made in projecting these impacts:

1) For no growth, it was assumed that the population of the Reno service area will remain constant until year 2000, and vehicular miles driven will also remain at their 1975 level. Consequently, emissions of carbon monoxide, hydrocarbons, and nitrogen oxides would decline until 1990 due to control devices on new vehicles. Emissions of sulfur dioxide and particulate matter from vehicular operations would remain constant owing to the absence of new controls for these pollutants. All other emissions from stationary sources would remain constant.

2) For full growth, it was assumed that the population of the Reno service area would grow as currently predicted despite the absence of adequate municipal wastewater treatment facilities. Septic tanks or other means of treatment could be provided. The assumptions used in projecting air pollutant emissions for full growth were explained previously for each pollutant and include the assumption that energy supplies continue to be available as at present.

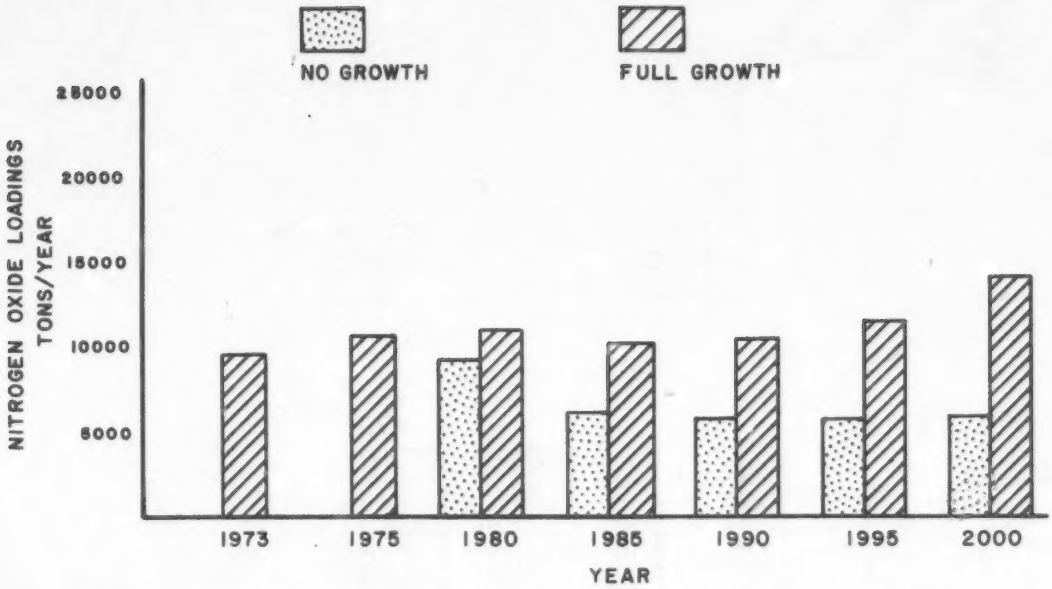
For population growths greater than no growth but smaller than full growth, impacts on air pollutant emissions would fall somewhere within the range illustrated in Figures 6-6 through 6-9.



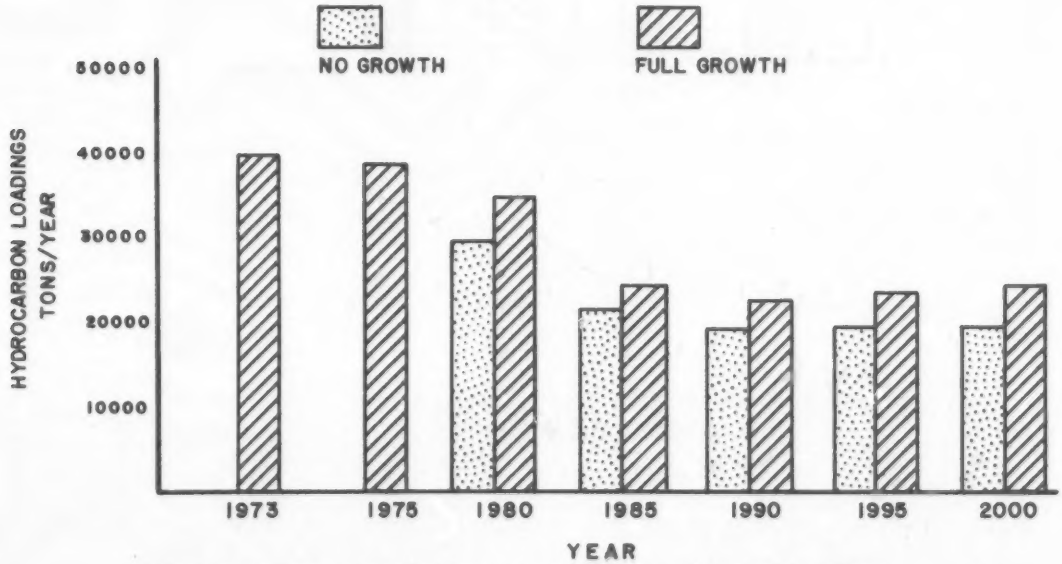
PARTICULATE AND DUST EMISSIONS -
NO ACTION ALTERNATIVE

Source: (TME projections
based on existing levels)

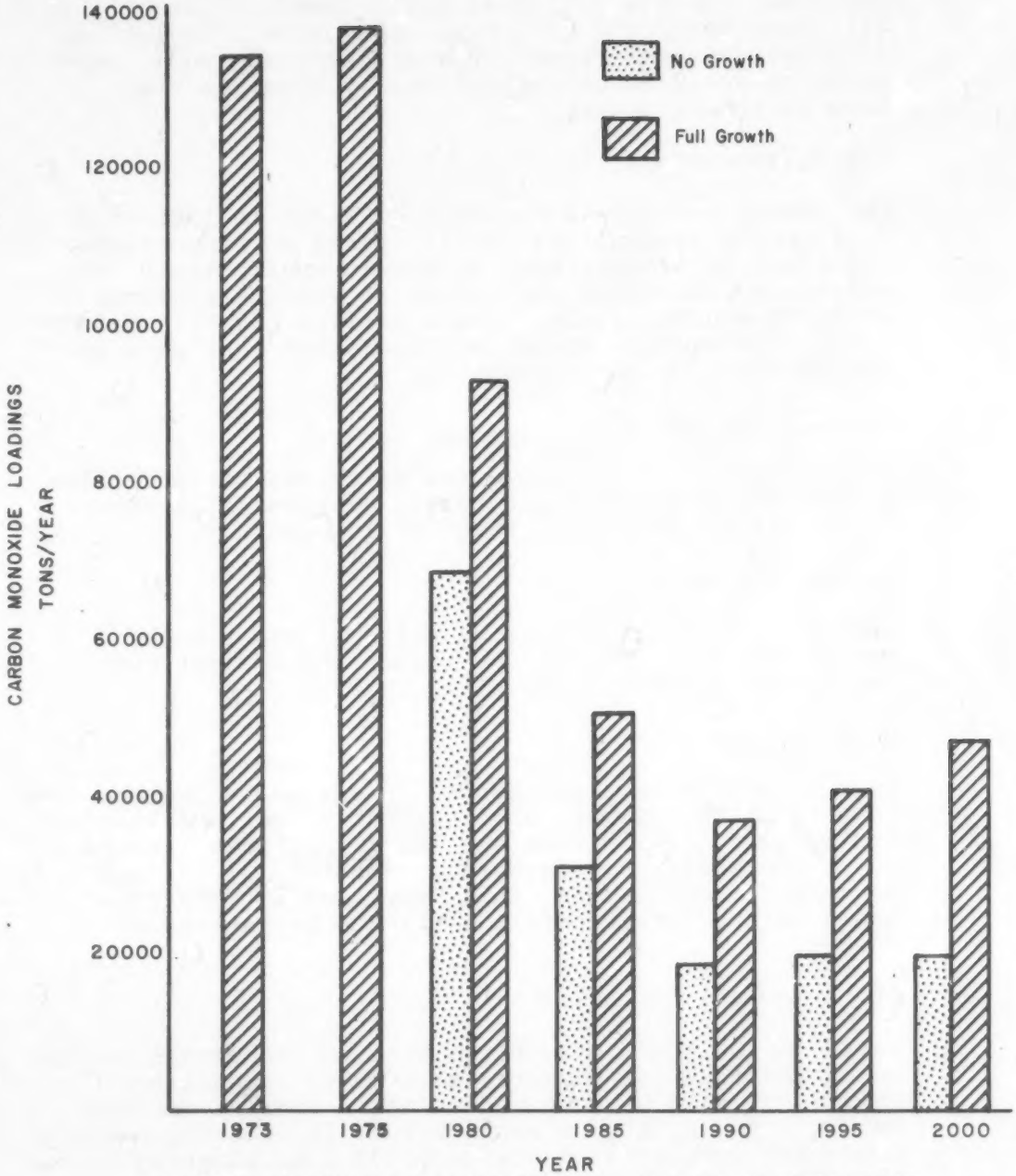
Figure 6-6



NITROGEN OXIDE LOADINGS - NO ACTION ALTERNATIVE
Figure 6-7



HYDROCARBON LOADINGS - NO ACTION ALTERNATIVE
Source: (TME projections based on existing levels)
Figure 6-8



CARBON MONOXIDE LOADINGS - NO ACTION ALTERNATIVE

Source: (TME projections based on existing levels)

Figure 6-9

Particulates

Emissions of this pollutant would remain constant for all years under the no growth assumption. Violations of primary annual geometric mean standards would continue to occur in urban portions of Reno, as they have in recent years.

Carbon Monoxide

The TMBAQS predicts attainment of NAAQS in 1981 under full growth assumptions (A-4). Based on proportional roll-forward projections, no growth would result in emissions reductions sufficient to produce attainment of NAAQS approximately 2 years earlier (1979). Maintenance of standards would continue after that date to the year 2000 with no growth.

Nitrogen Oxides

With no growth, nitrogen oxide emissions would decline after 1975 until 1990 and remain constant after that date. No violations of NAAQS would occur.

Sulfur Dioxide

With no growth, emissions of this pollutant would remain at their present low levels and ambient concentrations would remain close to zero.

Hydrocarbons

With no growth, hydrocarbon emissions would decline to a level approximately 50 percent of current loadings by 1990, and remain constant after that date. Based on proportional roll-forward projections of current maximum concentrations, this reduction in emissions would not be sufficient to eliminate violations of NAAQS.

Photochemical Oxidants

Based on the crude assumption that photochemical oxidant concentrations are directly related to hydrocarbon emissions, a 50 percent reduction in current maximum oxidant concentrations would result in lowering maximum concentrations of oxidants to 0.083 ppm, slightly higher than NAAQS, by 1990 and beyond that date.

IMPACTS OF TREATMENT PLANT ALTERNATIVES ON THE SITE ENVIRONS

Topography

The proposed treatment plant expansion will occur adjacent to and be an integral part of the existing facility. There will be no topographic impacts associated with the physical plant expansion common to all alternatives.

Sludge disposal is currently accomplished by on-site sludge drying beds with the dried product hauled away to landfill areas. Topographic changes associated with Concepts I and III consist of reclamation of land currently used for sludge drying, and excavation for a pipeline to transmit sludge and supernatant to the Spanish Springs irrigation site. Excavation for the sludge pipelines will cause temporary construction related topographic impacts. Topographic changes at the irrigation site will include flood and drainage control measures and construction related grading necessary to construct winter storage ponds when irrigation is impossible.

Under Concepts II and IV, existing sludge drying beds would be replaced by mechanical dewatering techniques with the dried product hauled to landfill sites. The estimated 60,000 lbs/day of dried material is not expected to cause significant topographic changes over a 20 year period.

No change in topography will be experienced if no action is taken.

Scenic and Aesthetic Characteristics

Expansion of the Reno-Sparks Treatment Plant will not materially alter the visual character of the plant site. There are, however, short and long term impacts associated with construction and plant operation.

Plant construction activities creating dust and smoke are viewed as short term impacts. Sludge disposal methods under Concepts II and IV involve regular activities which may be seen by persons in areas affected by sludge disposal. Mechanically dewatered sludge, for example, would be regularly hauled by vehicles routed to local landfill sites yet to be determined. The visual impacts on areas affected will be long term. Sludge disposal under Concepts I and III involving irrigation at Spanish Springs Valley will have a short term visual impact

on the pipeline corridor with construction and vehicle related dust and smoke. Irrigation at Spanish Springs will alter the aesthetics of the area by imparting agricultural activities on a small portion of the valley. Since similar activities by man are already evident in the area, this visual impact is not considered to be dramatic.

Should no action be taken, no scenic or aesthetic environmental changes will occur. However, the elimination of the existing sludge drying beds, which are a negative aesthetic feature in the floodplain of the Truckee River near the treatment plant site, would be prevented under the no project alternative.

Archaeologic Resources

The existing treatment plant and the proposed extent of expansion common to all alternatives are located on a pad which was cut out of the hillside. Because of this previous grading, it is unlikely that any surface archaeology could exist.

Impacts of the proposed project on archaeologic resources resulting from sludge disposal alternatives under Concepts I and III in Spanish Springs Valley are located in Section 36, T21N, R20E, and sites along the proposed sludge transmission line.

Thirty-seven sites, a majority of which contained one to ten artifacts, were discovered in Section 36. Three possible camp or task sites typified by artifacts scattered over an area of from 1 to 3,000 square meters have been identified as possible locations of subsurface material. Archaeologists and historians should be given ample opportunity to ascertain the potential for significant historical data to be obtained from these sites.

Thirty sites were discovered along the proposed sludge transmission line alignment, most of which contained few artifacts. Areas within Sections 22, 15, 14, 11 and 12 bounded by Spanish Springs Valley suggest a major winter village site which included seed processing activity. As mentioned in Chapter 4, these sites may be avoided by locating the proposed transmission line east of Spanish Springs Road.

Since sludge disposal sites for Concepts II and IV have not yet been designated, no specific archaeological impact is identified. Investigations of archaeologic value should be made when such landfill sites are located.

No potentially valuable archaeological sites will be encountered if no action is taken.

Soils, Geology and Seismicity

This project will consist of new primary and secondary sedimentation tanks, aeration and phosphorus stripping tanks, and digestion tanks. The new structures will be located adjacent to the main existing building which is situated on colluvial soils and volcanic bedrock of the Hartford Assemblage. The new additions will probably be underlain by similar soil and rock. According to the USDA Soil Conservation Service, the Aridisol soils consist of stony clays and silts on steep slopes which are low to moderately erodible, and have high shrink-swell potential. The soils are well drained and have a slow permeability. Faults are not known to exist at the site and landslide deposits are present. Groundwater is probably deep except just north of the site in the vicinity of Steamboat Creek where it flows into the Truckee River. Compressible alluvial soils exist north of Steamboat Creek. During site preparation, excavations may become unstable and could require temporary support. A disposal area may be needed for excess spoil. If fill is placed on compressible soils north of the plant site, settlement may occur. There will be increased dust and noise levels during site preparation and construction. Water spraying will reduce dust. The following short term impacts have been identified. Noise levels will not be excessive.

Long term adverse impacts on area geology could develop in the event of accident or earthquake. Spillage or rupture of tanks or lines could result in contamination of soil and groundwater. There is also the possible increase in contamination (including siltation) into the Truckee River. Additional long term impacts on the project from the geologic environment include possible damage to structure from ground shaking during major earthquakes and possible landslides in cut slopes south of the plant along the banks of Steamboat Creek.

Pipelines will carry digested sludge and phosphorus-rich supernatant from the Reno-Sparks sewage treatment plant to the proposed land reclamation and irrigation site in Spanish Springs Valley. The proposed pipeline route will cover mostly lowlying alluvium with high groundwater levels. Compressible surface soils exist between the Truckee River and the mouth of Spanish Springs Valley. These soils consist of clays and silts with high shrink-swell potential,

are moderately erodible and are well drained with slow permeability. Water bearing horizons range in depths between 70 to 300 feet. Disposal of treatment plant sludge and supernatant will require exploration borings to determine the ability of clay lenses to contain contaminates. Disposal of water could alter the rate of weathering of the soils and could cause swelling and decreased permeability of expansive-type soils.

The following long term impacts have been identified. If compressible soils are present, they could affect the pipeline if differential settlement were to occur. Contamination of the soil and/or groundwater could result if breaks develop. Expansive soils that may be present along the route could cause uplift on the pipe if not buried below the zone of shrink-swell influence. Similar conditions could affect shallow foundations of any structures servicing the pipeline. Rupture of the pipeline from faulting is unlikely since active fault traces are not known to exist along the route. Disruption of the pipeline from intense ground shaking during earthquakes is possible.

Under Concepts II and IV, sludge would be mechanically dried and stockpiled. Stockpile sites would have to be carefully selected and prepared so that no contaminate escape could occur from leaching, earthquake, surface runoff, or erosional forces.

"No project" will not cause impacts on area soils or geology. The potential for soil contamination in the service area, however, will be increased by line storage or peak sewage flows awaiting treatment. This contamination potential is further increased during wet weather when existing combined storm and sanitary sewer lines are likely to overload.

Climate and Air Quality

Increased suspended particulates are the major air quality impacts associated with construction of the plant expansion, pipelines, disposal sites, etc., and possible operation of a sludge incinerator. These impacts would not occur if no action is taken.

The construction and operation of the proposed facilities under Concepts I and III will have no forseeable long term impact on the climate and meteorology of the Truckee River Basin. Regional air quality will not be directly affected by implementation of this concept. Localized, temporary increases in suspended particulate concentrations in the air

at the plant construction site and the land treatment facilities (including the pipelines to Spanish Springs) can be anticipated. Construction vehicles will emit small amounts of nitrogen oxides, carbon monoxide, sulfur oxides, particulate matter, and hydrocarbons. These emissions should not be sufficient to cause a violation of air quality standards or observable change in air quality.

Operation of the fully expanded wastewater treatment plant may require additional personnel, but the small increase in traffic volume to and from the plant is not expected to contribute significantly to air pollutant concentrations along roadways leading to the plant.

During construction of the expanded plant, incinerator site, land disposal sites for dewatered sludge and the landfill for incinerator wastes under Concepts II and IV the local suspended particulate levels will temporarily increase. Particulate matter is the primary air pollutant associated with sludge incineration. Tests conducted at fluidized bed sludge incinerators in 1971 showed that uncontrolled particulate emissions average 94.5 lb/ton dry sludge (L-6). Based on the estimated sludge feed of 56 tons/day, uncontrolled particulate emissions due to sludge incineration would amount to 5,300 lb/day, or 1.9 million lb/yr. This would increase current particulate loadings by approximately 10 percent, and would constitute a significant adverse effect on regional air quality. The impact on local climate due to these additional emissions is likely to be very minor.

New Source Performance Standards (NSPS) promulgated by EPA in 1975 restrict particulate emissions from both new and modified sewage sludge incinerators to a maximum of 1.3 lb/ton dry sludge (E-29). Based upon estimates for uncontrolled incineration, a control system with collection efficiency of approximately 98.6 percent would be required. Systems capable of meeting EPA standards add approximately 4.4 percent to the cost over an unabated incinerator facility. Annual operating costs are estimated to be increased by 0.9 percent (E-30). Those collection systems capable of achieving this high effiiency as recommended by EPA are (E-29):

1) Venturi scrubber, operating at a pressure drop of approximately 18 inches of water.

2) Impingement scrubber, used in conjunction with an oxygen meter that automatically controls burning rate.

3) Electrostatic precipitator.

If NSPS are met at the proposed incineration plant, daily and annual emissions will be a maximum of 72 lb/day and 26,400 lb/yr, respectively, representing a relatively insignificant increase in current particulate loadings.

EPA has also promulgated an opacity restriction of less than 20 percent and tests at 21 sludge incinerators showed that all facilities were capable of meeting opacity standards (E-29).

No other gaseous opacity, organic, or metallic pollutants should present any significant air quality problems through the operation of a sludge incinerator of the size required at Reno. Incinerator emissions would not cause an odor problem since sewage sludge incinerators oxidize odors (L-6). Sludge conveying and feeding systems should be completely enclosed to further reduce odors.

Acoustics

Expansion of the JWPCP facility under all project alternatives will raise noise levels during construction to the 79 dBA to 105 range 50 feet from the noise source. This increase above the current ambient noise level of 55 dBA will be short term.

Irrigation alternatives of sludge disposal for Concepts I and III will also cause similar short term construction noise level increases along the pipeline and at the irrigation site. No long-term noise level increases are induced by plant operation or irrigation methods under Concepts I and III.

For Concepts II and IV, sludge disposal alternatives involve long term operation of noise producing loading, transport, and grading vehicles. SENEL's for vehicles typically used for such operations range from 85 to 90 dBA (50 feet from noise source).

No additional noise will be introduced to the area should no action be taken.

Urban Systems

- Transportation

  Expansion of the JWPCP to 40 MGD will require daily transport of construction materials, equipment, and personnel to and from the site. Impacts resulting from this movement upon local transportaton networks will vary with the stage of construction; for example,

grading equipment may be needed only at the beginning of construction, concrete and steel reinforcing at intermediate construction phases, and mechanical equipment near project completion. Similarly, craftsmen and labor will vary with project stages, and may vary in number and origin from day to day. Transportation impacts at the plant site are thus considered short term-construction related and considered to be common to all alternatives.

Under Concepts I and III liquid digested sludge and phosphorus-rich supernatant would be piped to Spanish Springs Valley. Construction of the 6 inch and 10 inch (respectively) pipelines will be adjacent to Spanish Springs Road and, therefore, may contribute to driver distractions. Construction of the north-south transmission lines may cause temporary interference with east-west interstate highway traffic. Possible delays or detours would necessitate cooperation with state highway officials, and may dictate one or possibly combinations of the following traffic control measures: 1) maintaining two traffic lanes in peak traffic flow directions, with one lane (possibly the shoulder) used for non-peak flows; 2) publicized road closure during minimum traffic hours; or 3) construction of detour lanes. Mitigating measures and recommendations for the selected project are contained in Chapter 7.

Concepts II and IV disposal Alternative B involves incineration of dewatered sludge and effluent disposal to the Truckee River.

Disposal Alternatives A and C require effluent disposal to the Truckee River and stockpiling of approximately 47,000 lbs/day of dewatered sludge at 40 MGD plant operation. Specific weights of dewatered sludge usually range from 40 to 60 pounds per cubic foot and therefore stockpiling would require truck transport of 111 to 169 cubic yards per day of sludge to a stockpile site. Transportation impacts relating to Concepts II and IV will therefore correlate with the number and length of transport trips per day.

Transportation will not be impacted with the no action (no growth) alternate.

- Solid Waste

All of the treatment plant expansion concepts will generate construction waste requiring disposal, and thus contribute to existing daily solid waste volumes. This impact is short term and minor because there is adequate solid waste disposal capacity available.

Concepts II and IV will have long term solid waste impacts resulting from landfill disposal of dried sludge. The estimated 60,000 pounds per day of dried material is considered of minor quantity in respect to the total solid waste production of the service area. From a quality standpoint, however, particular care must be taken to insure that no surface or groundwater contamination results from the sludge disposal operations, thus impacting site and operational considerations. Since removal of the sludge drying beds from the floodplain is a current requirement, the no growth alternative will still require a positive action in regard to sludge disposal. Thus, no growth implies the same action as in Concepts II and IV with one half of the quantitative impact.

- Drainage and Flood Control

The proposed JWPCP expansion under all alternatives will remove existing sludge drying beds from the floodplain of the Truckee River in compliance with State Directives. This impact is beneficial since the potential health hazard which would result from sludge drying bed inundation is eliminated.

- Existing Regional Sewerage Facilities

The expanded JWPCP will relieve the existing facility from its capacity loads, and eliminate the necessity for line storage of peak flows. Expansion requires additional personnel at the facility, and may create maintenance positions for the proposed irrigation operations at Spanish Springs Valley under Concepts I and III. This aspect is discussed in the employment section of this chapter.

Impacts of all project alternatives on the existing wastewater treatment system of the Reno-Sparks service area are considered beneficial. The proposed upgrading

of treatment processes to include tertiary treatment components and expansion of existing plant capacity to accommodate project flows will assure the required pollutant removal specified in the NPDES permit. Existing facilities will constitute the foundation of the action proposed; thus, no significant economic losses are projected due to abandonment. The proposed expansion program is compatible with the Areawide Water Quality Management Plan (W-1).

Under the no project alternative and projected growth through the year 2000, impacts on the existing wastewater treatment plant will be overloading of the facility by increasing wastewater flows. Overloading of the facility will result in reduced pollutant removal efficiency, probable bypasses during peak flows and, therefore, serious impacts on the water quality and aquatic ecosystem of the Truckee River and Pyramid Lake.

- Water Supply

The project and no project alternatives do not directly impact the water supply system of the area. There are, however, differentials in the effluent discharge volumes for various alternatives which are briefly outlined here. The impact of these outflow rates on downstream water quantity in the lower Truckee River and Pyramid Lake are discussed later in this section.

Alternative Concepts I and III contains the land treatment alternative requiring the export of water to Spanish Springs Valley. Consequently, a certain amount of the effluent water would not return to the surface flow of the Truckee River. The relative volumes of water which would be diverted are dependent upon the amount required for irrigation of the crop to be grown there. Estimates of these volumes range from 5.4 MGD to 0.7 MGD depending upon the alternative operation of the land treatment site. Water applied to the irrigation site at Spanish Springs, while not immediately re-entering the Truckee River, will serve to augment the groundwater supply in Spanish Springs Valley.

Alternative Concepts II and IV would discharge the entire treated plant effluent into the Truckee River. This alternative would have no significant adverse impact on the water quantities returning to the Truckee River.

- Energy Supply

In general, the increased energy requirements of the expanded JWPCP under the project alternatives are a minor part of the future energy demands of the Truckee Meadows area under the predicted growth accommodated by the plant expansion. As such, no direct impact on the energy supply and distribution system except as part of overall expansion is entailed by the project alternatives. Comparison of the energy requirements for the various concepts are discussed in the following paragraphs.

Concept I has the lowest energy requirements since it involves irrigating and installing improved air diffusion systems for the activated sludge system. Energy estimates vary from 11.75 x 10^6 kwhrs to 27.95 x 10^6 kwhrs, depending upon the operational alternatives.

Concept II requires an increase in energy consumption as this alternative includes the mechanical dewatering and incineration of sludge from the treatment process. Energy estimates vary from 9.64 x 10^6 kwhrs/yr to 168.6 x 10^6 kwhrs/yr depending upon the operational alternatives. Other sources of potential energy consumption contained within Concept II concern fuel depletion caused by vehicles required to transport dewatered and incinerated sludge to landfill disposal areas.

The primary impacts of energy consumption attributed to the Concept III Alternative are similar to those proposed for Concept I. Energy estimates vary from 37.3 x 10^6 kwhrs/yr to 61.75 x 10^6 kwhrs/yr, consumption slightly higher than the Concept I Alternative due to a modified activated sludge process that requires activated carbon and the use of pure oxygen.

The primary impacts of energy consumption attributed to the Concept IV Alternative are similar to those proposed for Concept II. Energy estimates vary from 35.19 kwhrs/yr to 58.64 kwhrs/yr, the variance from

Concept II attributable mainly to an increased oxygen requirement during treatment and the task of the incineration alternative.

Under the no project alternative the plant facilities under consideration would not be expanded or upgraded. Thus there would be no impact on the energy consumption rate presently utilized. The present estimate of energy consumption is 9.7×10^4 kwhrs/yr.

Economics and Employment

The capital costs of implementing the JWPCP expansion range from $12.0 to $29.7 million (1975 costs), depending on the specific alternate. The annual operating and maintenance (O & M) costs range from $0.8 to $5.6 million. The comparative present worth ranges from $24.5 to $76.9 million (assuming a 20 year amortization, 1975 dollars; 7 percent interest rate and present worth factor of 10.5940). These figures, by Concept Alternative, are shown in Table 6-M. Generally, Concepts I and III, involving export and irrigation of sludge, have lower annual costs but have higher capital costs because they involve construction of over 10 miles of tandem pipelines to Spanish Springs Valley and purchase of an irrigation area, pumps, sprinkler systems, ponds and dikes, which Concepts II and IV do not have. Concept I has the lowest O & M range of the concepts because it involves the smallest quantity of chemicals and energy input and has a comparatively low labor requirement.

Funding for the treatment plant expansion under all alternatives is expected to be derived from federal sources, according to the provisions of PL 92-500, Section 201 amounting to 75 percent of the total capital costs (K-1). Local contributions will furnish the remaining 25 percent. The Cities of Reno and Sparks entered into a cooperative agreement on March 11, 1974, which among other things, contains provisions for allocating costs between the two cities.

The proposed plant capacity expansion will be allocated as follows: 17 MGD to Reno and 3 MGD to Sparks. Total Reno ownership will increase from the current 10 MGD to 27 MGD; Sparks ownership will increase from 10 MGD to 13 MGD. Capital costs for the capacity expansion will be allocated accordingly: 17/20 to Reno and 3/20 to Sparks. Costs for improved treatment (phosphorous removal, sludge, exportation and irrigation, etc.) will be allocated according to total ownership 27/40 for Reno and 13/40 for Sparks. Sparks is given some credit for certain costs associated with upgrading the aeration tanks (K-1).

TABLE 6-M

ECONOMIC COMPARISON OF ALTERNATE CONCEPTS

	Capital Costs Millions	O & M Millions	Present Worth Millions	Personnel Requirements	Permanent Construction Employment	Energy Million KWH/yr	Total Chemicals Pounds/day
Concept I	$22.5-$29.7	$0.8-$1.2	$32.8-$42.9	26-30	405-535	11.75- 27.95	7,400- 14,200
Concept II	14.1- 21.5	1.1- 1.7	25.9- 37.7	28-36	254-387	9.6 -168.6	18,800-123,600
Concept III	20.4- 24.3	1.2- 5.1	34.3- 76.9	28-32	367-437	37.3 - 61.75	7,400- 14,200
Concept IV	12.0- 13.2	1.5- 5.6	24.5- 72.9	33-36	216-238	35.2 - 58.6	8,800- 22,400
No project	-	0.6	6.7	23		9.7	1,600

Operation and maintenance costs will continue to be distributed in proportion to the wastewater flows from the two cities. Currently this proportion is 75 percent for Reno and 25 percent for Sparks. The Kennedy facility plan has assumed the flows will be in relationship to total ownership after 1980.

Local funding for Reno for its share of the facility expansion is expected to be derived from issuance of general obligation bonds for a 20 year term. Debt servicing and plant O&M are funded from ad valorem taxes, sewer service charges and connection fees. Ad valorem taxes are limited by state constitution to 5 percent of the assessed value (35 percent of cash value). Currently Reno's tax rate is at the legal limit. However, taxable assessed value increases from new residential, commercial and industrial development and from inflation are estimated to be sufficient to cover increases in O & M associated with increased wastewater flows. Debt servicing will require additional revenues of approximately half a million dollars annually beginning 1 year after the bonds are issued. The probable source of these funds is an increase in either or both the sewer-service charge or the sewer connection fee. It should be noted that funds for the project have not been appropriated at this time.

Local funding for Sparks will also be derived either from accumulated capital reserves or from the issuance of 20 year bonds which will be repaid from sewer service charges and sewer connection fees. Increases in O & M costs are estimated to be funded by increases in total sewer services fee revenues derived from population increases (K-1). Debt servicing, amounting to approximately $130,000 annually beginning 1 year after the bonds are issued, will be funded from sewer service charges and sewer connection fees (K-1), either or both of which may have to be increased.

Alternatives are estimated to require total employment of 26 to 36 people, including the current 23 employees, for 40 MGD treatment. Generally, Concepts I and III (sludge export and irrigation) involve fewer people than Concepts II and IV which require more labor to accomplish disposal of sludge. Man years of construction employment is estimated between 216 and 535, varying directly with the capital costs (see Table 6-F).

The no project alternative involves no new capital costs. Currently, the plant has operating and maintenance costs of $0.6 million annually. Present worth of the plant is estimated at $6.7 million (K-1). The plant currently uses 1,600 lb/day of chlorine and would require no other chemicals.

The plant currently employs 23 people. This alternative involves no bond financing or impact on sewer service charge or connection fees. It should be noted that annual costs may increase in the future from inflationary pressures, necessitating increases in service charges and fees, unrelated to expansion. Even if the no project alternative is selected, phosphorous removal will be mandated in the near future to comply with the NPDES permit. Therefore, to view the no project alternative in true perspective, the capital and O & M costs for phosphorous removal are as follows: capital costs, $3.3 million; O & M, $0.2 million (or a total of $0.8 million when added to the current O & M).

IMPACTS OF TREATMENT PLANT ALTERNATIVES ON THE RELATED ENVIRONS (LOWER TRUCKEE RIVER, PYRAMID LAKE, SPANISH SPRINGS VALLEY)

Surface Water Hydrology - Concepts I and III

The primary impacts of implementing Concepts I and III on the surface water hydrology/water quantity of the Lower Truckee River Basin are associated with the export of water to the proposed land treatment area in Spanish Springs. Impacts on water use and availability are associated with population growth and concomitant water needs, as previously set forth in the discussion of impacts at regional scale.

Concepts I and III embody three separate sludge disposal alternatives (F, G and H) that entail slightly different impacts upon the Truckee River Basin surface water hydrology. Impacts of the alternative concepts on the flow in the Truckee River are summarized in Table 6-N. The primary impact of each of these alternatives is the diversion of a portion of plant effluent to the sludge and phosphorus supernatant disposal site in Spanish Springs Valley. Depending upon disposal practices, some of this water may find its way into the North Truckee Drain, and subsequently return to the Truckee River. However, most of the water exported to Spanish Springs Valley would be lost through evapotranspiration from crops and phreatophytes, or under proper management, made available, in part, as a groundwater resource.

Alternative F proposes irrigation and sub-surface leaching at the Spanish Springs Valley site. Under this alternative and a 40 MGD capacity, a total of 44,700 acre-ft/yr of water would enter the plant. Of this total, 38,700 acre-ft/yr will be discharged from the plant to the Truckee River. The difference, about 6,000 acre-ft/yr, would be pumped to Spanish Springs Valley

TABLE 6-N

CONCEPTS I AND III: ALLOCATION OF PLANT EFFLUENT

	Alternative F[a]		Alternative G[a]		Alternative H[a]	
Discharged directly to Truckee River		38,700		41,100		43,500
Pumped to disposal site		6,000		3,600		1,200
Irrigated	3,600		3,600		1,200	
Sub-surface leached	2,400		-0-		-0-	
	6,000		3,600		1,200	
Estimated fraction of water pumped to disposal site that will discharge to North Truckee Drain via groundwater	one-fourth (1,500)		one-fourth (900)		None (-0-)	
		40,200		42,000		43,500
TOTAL WATER TO TRUCKEE RIVER						
Plant Discharge	38,700		41,100		43,500	
North Truckee Drain	1,500		900		-0-	
TOTAL	40,200		42,000		43,500	

NOTES: [a]All values given in acre-ft/yr

as phosphorus-rich supernatant and sludge (3,600 acre-ft/yr for irrigation and 2,400 acre-ft/yr for sub-surface leaching). This difference represents approximately 1 percent of the present average flow in the Truckee River at Steamboat Creek and is equal to the potential increase in runoff from urbanization of Truckee Meadows.

Supernatant and sludge amounting to 3,600 acre-ft/yr would be used for irrigation during the summer months. Since measures would be taken to prevent direct surface runoff, this irrigation water would percolate into the upper soil layers and supply the water needs of crops and phreatophytes. Some of this water would evaporate soon after application and some would be transpired by crops and phreatophytes; the remainder would enter groundwater storage (see Table 6-N).

Current irrigation for agricultural purposes in the Truckee River Basin generally requires 5.5 acre-ft/acre application. An average of about 2.0 acre-ft/acre (37 percent of application) dissipates through evapotranspiration (S-7). On the basis of these water use estimates for Alternative F, approximately 2,700 acre-ft/yr of the irrigated flow would be lost through evapotranspiration and 900 acre-ft/yr would enter the groundwater.

During winter months, the phosphorus-rich supernatant would be subsurface leached (discharged into substrate below ground surface) at the Spanish Springs irrigation site, while the sludge would be stored until warmer weather permitted surface irrigation. An estimated 2,400 acre-ft/yr would be leached below the surface. This water will enter the groundwater in Spanish Springs and either be made available for use via wells, be transpired by phreatophytes, or will enter the Truckee River Drain via groundwater flow. Assuming an average consumption rate of 75 percent, of the 6,000 acre-ft/yr exported to Spanish Springs Valley, approximately 4,500 acre-ft/yr would be lost through evapotranspiration; about 1,500 acre-ft/yr would enter the groundwater system, and could seep into the North Truckee Drain.

Under Alternative F, the net water return to the Truckee River would amount fo 40,200 acre-ft/yr, which represents approximately 90 percent of the plant influent at 40 MGD.

Alternative G involves irrigation practices at the Spanish Springs Valley site, but eliminates the need for sub-surface leaching. The water budget for the treatment plant operating

under this alternative is also presented in Table 6-N. Approximately 41,000 acre-ft/yr would be discharged directly to the Truckee River, and the remaining 3,600 acre-ft/yr would be diverted to the irrigation site in Spanish Springs Valley. Assuming that 75 percent of the irrigation flow (2,700 acre-ft/yr) is lost through evaporation and transpiration, approximately 900 acre-ft/yr will enter the groundwater and may eventually seep into the North Truckee Drain. This flow could return to the Truckee River.

The net return flow to the Truckee River under Alternative G is estimated to be 42,000 acre-feet annually, or 94 percent of the plant influent.

Alternative H reduces water exported to Spanish Springs Valley by reducing the amount of supernatant to be used for irrigation. Under this alternative, approximately 1,200 acre-ft/yr is pumped to the irrigation site as supernatant and sludge. Most of this water would be lost through transpiration from crops and phreatophytes and from direct evaporation. Because of the relatively small volume of water involved, it is assumed that all 1,200 acre-ft/yr would be consumed.

Under Alternative H, 43,500 acre-ft/yr of the plant influent would reach the Truckee River. At an operating level of 40 MGD (44,700 acre-ft/yr), this discharge is equivalent to 97 percent of the plant influent.

Surface Water Hydrology - Concepts II and IV

Under Concepts II and IV, a conventional activated sludge system followed by either sludge landfilling or incineration would eliminate the need for irrigation. Almost all plant influent would eventually be discharged to the river after treatment, as shown in Table 6-O. In Alternative A, sludge would be dewatered and transported by truck to a landfill. An estimated 11 acre-feet of water per year would remain in the sludge and be lost to the landfill, where it would evaporate to the atmosphere.

Under Alternative B (involving sludge incineration), the sludge would be dewatered prior to its combustion. Very little water would be lost under this alternative (about 10 acre-ft/yr).

For Alternatives A and B, effectively 100 percent of the plant influent would be discharged to the Truckee River.

TABLE 6-O

CONCEPTS II AND IV: ALLOCATION OF PLANT EFFLUENT
(acre-ft/yr)

	Alternative A	Alternative B	Alternative C
Discharge to River	44,700	44,700	44,500
To Sludge Disposal	11	10	220
TOTAL (rounded)	44,700	44,700	44,700

Source: (TME)

Alternative C involves dewatering and landfilling of all sludges, with water losses of about 220 acre-ft/yr. As a result, about 44,500 acre-ft/yr would reach the Truckee River for a 99.5 percent return rate of the plant influent.

Under a no project situation, these water losses would be reduced by approximately 50 percent. Impacts on the hydrology of the Truckee River system resulting from increases in water use are described as impacts at regional scale.

Surface Water Hydrology - No Project

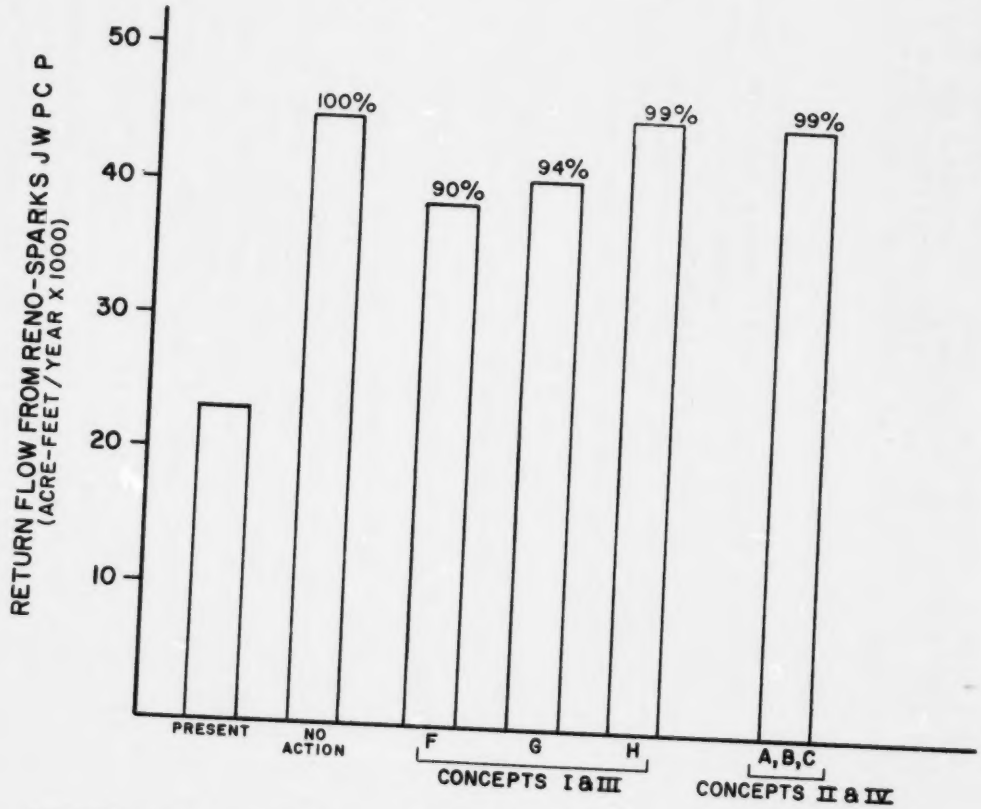
If the plant expansion and upgrading of treatment do not occur, the existing facilities will exert no new impacts on the quantity of water in the Truckee River. Increased water demand by the growing population will result in an increase in wastewater flows to the existing plant, all of which will eventually return to the river except for 0.5 percent (as in Alternative C above) as the result of sludge dewatering and landfill disposal.

The comparative return flows for all treatment plant alternatives are shown graphically on Figure 6-10.

Surface Water Quality - Concepts I, II, III and IV

Utilizing a water quality model, quality parameters have been predicted for the Truckee River (R-32) from Steamboat Creek to Derby Dam for each of the five treatment alternatives including the no action alternative (see Appendix 8). Predictions were made for both the project and no growth cases. The project involves increased flows to about 40 MGD while no project indicates that wastewater flows would remain at the present level (about 20 MGD). Water quality parameters that were simulated included temperature, pH, BOD, dissolved oxygen, nitrate, total phosphate, total dissolved solids, chloride, and fecal coliforms. These predictions served as primary input into the assessment of impacts on water quality and on aquatic biota. The model simulation was accomplished for August conditions which have historically reflected low flow conditions in the Truckee River.

If anticipated growth in the Reno area occurs, coupled with an increase in wastewater flow at 40 MGD and improved treatment, total phosphate concentrations in the Truckee River from Reno to Derby Dam will be reduced by a maximum of



Source: (TME)

RETURN FLOWS OF TREATED WASTEWATER TO TRUCKEE RIVER
(% OF INFLUENT AT 40 MGD)

Figure 6-10

40 percent (Concepts I and III) and a minimum of 30 percent (Concepts II and IV); nitrate and BOD concentrations will increase significantly, total dissolved solids will increase by 10 to 20 percent and chloride levels will increase by about 10 percent. The reduction in phosphates will enable state standards to be met most of the time although violation of the single value standard could continue to occur (Concepts II and IV resulting in more extensive violations than I and III). While nitrates, BOD, and total dissolved solids concentrations will increase, standards will generally not be exceeded. Average chloride concentrations will be nearly equivalent to the state single value standard with violations expected to increase in frequency and magnitude over existing conditions. Because the Reno area has very limited heavy industry that could discharge substances that may offset the taste of fish (e.g., phenols) there will likely be no problem with flesh tainting substances in the wastewater.

Due to a paucity of sampling data on ammonia levels in the plant effluent or in the Truckee River, this parameter was not simulated. However, the cursory data for the Truckee River taken during the semi-monthly monitoring program by the U. S. Geological Survey placed ammonia levels at Lockwood (3.3 miles downstream of Steamboat Creek) between 0.00 and 0.99 mg/l during the water year of October 1974 to September 1975. Much of this ammonia is thought to be attributable to the Reno JWPCP. Increased wastewater flows to 40 MGD should significantly raise ammonia concentrations in the Truckee River. Consistent ammonia levels of above 1.0 mg/l, which are likely if plant effluent flow is doubled and no ammonia removal measures implemented, are well above the recommended EPA concentration of 0.02 mg/l for un-ionized ammonia for the maintenance of healthy freshwater ecosystems (E-40).

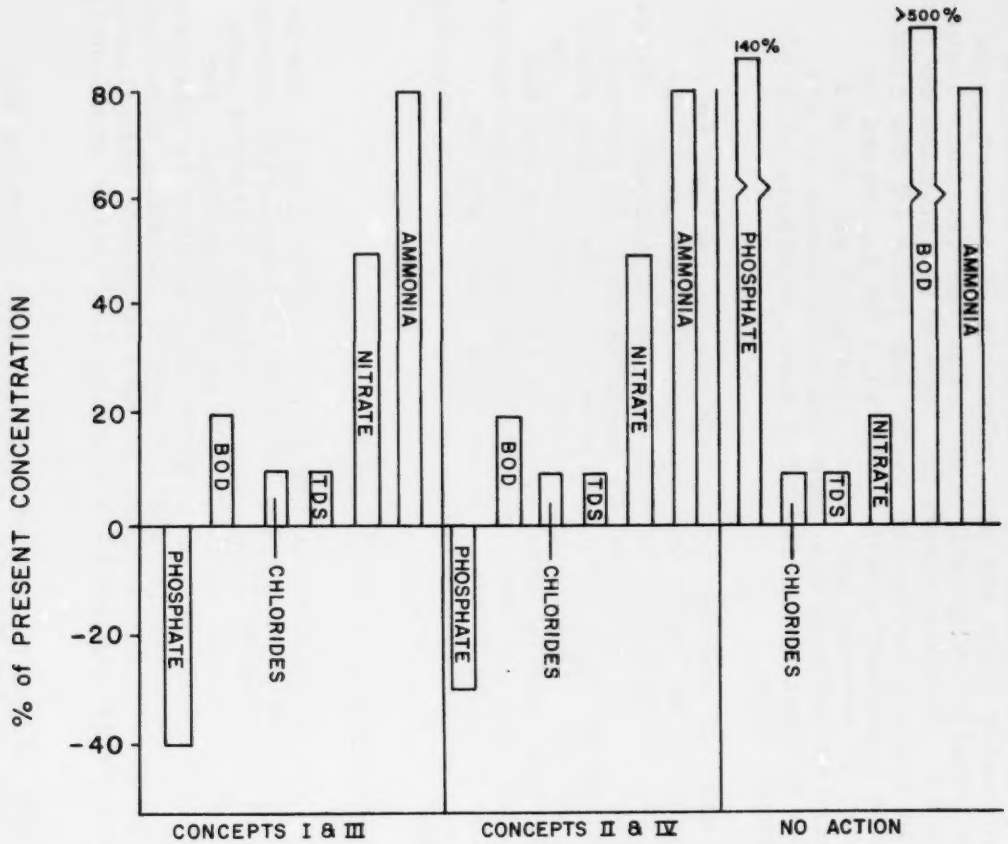
Nitrification of ammonia will occur naturally in the Truckee River below the plant outfall, but the rates of nitrification and the distance of the stream that will experience high concentrations depend on many factors such as effluent concentrations, background concentrations in the river, water temperature, and stream flow. Without additional ammonia monitoring data, accurate predictions of the river concentrations are impossible.

The practice of disinfecting wastewater treatment plant effluents with chlorine usually results in residual chlorine in the receiving stream. The toxicity of residual chlorine

and chloramines (which are the result of interactions between chlorine and ammonia compounds) to organisms has recently been clarified. The present chlorination practices at the Reno JWPCP average a 5.1 mg/l dose in the wastewater. Measurements of residual chlorine have shown levels in the receiving stream to be 0.2 to 0.5 mg/l (D-9). Increasing the use of chlorine as wastewater flows increase will raise the residual concentrations in the receiving stream and thereby increase the potential detrimental effects of the plant effluent on the aquatic life in the Truckee River below the plant outfall. Although the acceptable levels of chlorine in any environment are dependent upon many factors, it can be stated that the increase in residual chlorine in the Truckee River, based upon toxicity studies with salmonids (E-27, B-26) would be detrimental to the fishery of the river. Recommended residual chlorine concentrations to protect salmonids are 0.002 mg/l as established by the USEPA (E-40).

Under a no growth condition with plant upgrading, water quality in the Truckee River in the reaches from Reno to Derby Dam would remain relatively unchanged. The major exception is total phosphate whose concentration would be reduced to about one-half of the existing level due to the proposed tertiary treatment of plant effluent. This reduction in phosphates would result in the average August concentration in the river being roughly equivalent to the Nevada single value standards. Violations of the single value standard will continue, but at a reduced rate and reduced magnitude. A comparison of selected water quality parameters predicted for the Truckee River for each alternative is presented in Figure 6-11.

For the project and no growth cases, dissolved oxygen levels would normally remain at values greater than 7.5 during August. Lower oxygen levels would be observed during the early morning hours when algal respiration tends to decrease dissolved oxygen concentrations. Violations of the single value standards for dissolved oxygen can be expected to occur periodically due to algal respiration. It is extremely difficult to accurately model dissolved oxygen in the Truckee River for several reasons. Dynamic models should be used to predict diurnal variations. However, sufficient diurnal water quality measurements for model formulation and calibration/verification are lacking. Sufficient data on the nitrogen forms and benthal loads are not available to enable benthal consideration or nitrification to be



TRUCKEE RIVER WATER QUALITY
PREDICTED CHANGES IN CONCENTRATIONS OF SELECTED
PARAMETERS BELOW RENO JWPCP AT 40 MGD
AND AUGUST (LOW FLOW) CONDITIONS

Source: (TME)

Figure 6-11

incorporated into the model. As a result of these considerations, the products of this model study must be viewed as approximations.

Under Concepts I and III, water quality below Derby Dam and entering Pyramid Lake is predicted to contain reduced concentrations of phosphorus on the order of 40 percent for a 40 MGD wastewater flow and approximately 50 percent reduction if no population growth occurs but the tertiary treatment is added. Nitrate concentrations will increase on the order of 50 percent below the Derby Dam for a 40 MGD flow at the waste treatment plant. BOD will be increased on the order of 20 percent and total dissolved solids and chloride concentrations are expected to increase on the order of 10 percent above existing concentrations with 40 MGD wastewater flow.

Under Concepts II and IV, phosphate concentrations in the Truckee River below Derby Dam and entering Pyramid Lake are predicted to decrease by a factor of 25 percent. Nitrate concentrations will increase by approximately 50 percent. Both estimates are based on a wastewater flow to the plant of 40 MGD. At this flow level, total dissolved solids are expected to increase by approximately 10 percent and BOD by 20 percent over current concentrations at average August flows in the Truckee River. Other parameters are not expected to change significantly below Derby Dam or entering Pyramid Lake.

Surface Water Quality - No Project

The impacts on surface water quality associated with the no action alternative concept are related to population growth (= increased wastewater flow) and a reduced treatment capability of the existing facility due to overloading. For comparative purposes, the no project alternative is discussed in relation to expected population growth assuming necessary urban facilities. If the plant is not expanded, urbanization will proceed utilizing local treatment facilities and septic tanks.

The selection of the no action concept will increase BOD concentrations in the Truckee River immediately below the JWPCP to 18 mg/l at a 40 MGD wastewater flow. This will result in a distinct DO sag downstream to Derby Dam with minimum oxygen levels during low flow periods of about 5.5 mg/l, significantly below standards. Total dissolved solids and chloride concentrations will increase by about 10 percent

and nitrate by 20 percent. The decrease in retention time will further limit in-plant nitrification and increase effluent ammonia concentrations. Total phosphate levels will increase by over 100 percent resulting in nearly continuous violation of state standards during August.

The no action alternative should exert virtually no changes on the temperature or pH of the Truckee River at Pyramid Lake. Temperature standards at Ceresola Ranch will continue to be exceeded on a regular basis during the summer months. The increase in TDS will serve to accelerate the rate of salinity increase in Pyramid Lake, although by only a small amount. Chloride and TDS concentrations in the river will be below the state standard at Ceresola Ranch.

Phosphate concentrations in the river entering Pyramid Lake will increase significantly under growth-but-no-project conditions. As a result, state phosphate standards would probably frequently be exceeded at Ceresola Ranch. Significant increases in nitrate concentrations are anticipated for conditions associted with a 40 MGD wastewater flow. Dissolved oxygen concentrations in the Truckee River at the mouth would be reduced by about 50 percent during the summer. State stream standards for dissolved oxygen would be violated on a regular basis during the summer at Ceresola Ranch. These low dissolved oxygen concentrations could pose some localized oxygen problems in the lake in the areas adjacent to the Truckee River mouth, but the lake as a whole, due to the dilution factor, should not be adversely impacted by the reduction in oxygen resources. BOD concentrations at the river's mouth would also increase dramatically and the state BOD standards at Ceresola Ranch would frequently be exceeded.

Flora and Fauna - Concepts I and III

For Concepts I and III the level of phosphate projected for JWPCP effluent (2.3 mg/l or 234 lb/day) represents a significant reduction from the present mean level of 5.2 mg/l. The phosphate concentration at the point of complete effluent mixing in the river would drop from the present low flow (August) mean of about 1.0 mg/l to about 0.6 mg/l (R-32). This drop would contribute to the suppression of downstream eutrophication and require algal productivity, which will be a long term beneficial impact on aquatic life. The effluent/river mixing concentrations of nitrate would increase by approximately 50 percent, which represents an adverse addition of nutrients to the Truckee River system. Recent laboratory culture studies have shown Nodularia spumigena,

the dominant nuisance blue green algae in Pyramid Lake, is phosphorus limited. Therefore, increases in nitrate concentration in the lake should not induce future algal productivity and the reduction in phosphorus predicted for the Truckee River, may reduce algal productivity in the lake. It should be noted that the predicted benefits to aquatic life as a result of phosphorus reductions could be offset by increases in nitrates, carbon, etc. which will result from increased sewage flows.

The effluent/river mixing concentrations of BOD, DO and TDS under Concepts I and III would be essentially the same as present August means for these parameters (R-32). Mid-surface lake TDS were measured at 5,349 ppm at Pyramid Lake in August 1975 (K-5), and the U. S. Fish and Wildlife Service has stated that the lake's TDS must not exceed 7,000 ppm if a viable fishery is to be maintained (I-1). The proposed action udner Concepts I and III will not significantly change existing TDS additions to the Truckee River or Pyramid Lake.

Existing ammonia levels in the Truckee River below Steamboat Creek have been recorded as high as 0.99 mg/l during the 1974 to 1975 water year by the U. S. Geological Survey. The average level was 0.41 mg/l for 23 different samplings taken at Lockwood, approximately 3 miles downstream from Steamboat Creek. The literature concerning ammonia toxicity is difficult to apply to a dynamic system because the toxicity of un-ionized ammonia is dependent upon pH, temperature, dissolved oxygen concentrations and other chemical conditions. However, after a review of the relevant data, the USEPA concluded that "no concentration greater than 0.02 mg/l is recommended for freshwater environments at any time or place" (E-40). These criteria serve to protect the most sensitive aquatic forms during all phases of their life histories. The anticipated un-ionized ammonia levels in the river which will result from increased wastewater flows from the proposed plant will very likely have adverse effects on the aquatic community of the Truckee, including the threatened and endangered fish species. Likewise, anticipated increases in residual chlorine levels will adversely affect the aquatic biota downstream of the plant outfall and, together with increased loadings of ammonia, could present some chemical barrier to faunal movements immediately below the sewer outfall. Recommended residual chlorine levels are 0.002 mg/l for salmonid fish (E-40).

Alternative combinations employing F represent the greatest potential annual water loss to the Truckee River system (6,000 acre-ft/yr) and therefore Pyramid Lake (assuming little or no groundwater return). Alternative G would cause intermediate losses, (3,600 acre-ft/yr) and H represents the lowest water losses of the three alternatives (1,200 acre-ft/yr). To maintain a constant water level in Pyramid Lake, an additional 136,000 acre-feet must be appropriated to the Truckee River (M-7). Any additional water loss to the river and lake (as Alternatives F, G and H propose) must then be considered as a long term adverse impact on the aquatic life of Pyramid Lake.

The predicted effluent/river mixing temperature of ≈68°F in August would still meet the recommended water temperature for summer maximum in a good trout stream (M-2). Other water quality parameters predicted for the river are not expected to impact the aquatic biota.

The endangered Lahontan cutthroat and Cui-ui have been the object of various management programs conducted by the State of Nevada and federal government. These programs are designed to re-establish naturally reproducing populations of these species in the lower Truckee River-Pyramid Lake system. These species have been maintained in recent years through breeding and stocking programs. The lower Truckee River is essential to the success of the management program and, therefore, reducing the pollution load through advanced wastewater treatment is critical to the fishery of the river and lake system. For most chemical parameters, the proposed action under Concepts I and III will not harm the fishery. However, the increased ammonia levels which will result if expansion and population growth occurs in the service area and increased chlorine concentrations downstream of the outfall will adversely affect the fishery of the lower Truckee-Pyramid Lake system and particularly the endangered Lahontan cutthroat and Cui-ui.

Sludge disposal alternatives (F, G and H) in Concepts I and III require construction of two adjacent pipelines across the Truckee River at a point approximately 0.5 mile upstream of the confluence with Steamboat Creek. Construction would cause additional sediment loading of the river and sediment loading with inorganic silts can reduce both species diversity and population densities of aquatic biota, particularly bottom organisms (M-8). The extent and duration of damage increases

proportionally with quantity and duration of sediment loading. Damage will be increased if sediment loading occurs during summer low flow and if it occurs when trout eggs could be destroyed by smothering (from March through May). This impact can be restricted to a short term adverse one if construction is closely controlled to minimize sediment loading of the river.

There are a number of ponds in Spanish Springs Valley. Any addition of nutrients to these water bodies through groundwater infiltration, which could result from overloading or mismanagement of the treatment site, will adversely affect the biota of these water bodies.

The terrestrial plant communities near the existing wastewater treatment plant are largely sagebrush scrubland that has a history of disturbance. The big sagebrush-grass community is the dominant association in the Lower Truckee River Basin. Plant expansion is expected to affect approximately 5 acres of land immediately adjacent to the present facility. This area will be removed from productivity for the life of the project and represents a minor long term adverse impact.

Disruption of aquatic and riparian plant communities as a result of pipeline crossings of the Truckee River to service the land treatment site will occur. During construction in the river bed, increased sediment loads to downstream areas of the Truckee River will occur and inhibit or destroy silt-intolerant aquatic macrophytes.

Native vegetation (mainly sagebrush communities) in the immediate construction zone of the pipelines along Spanish Springs Road to the land reclamation site will be destroyed and its usefulness as habitat for desert wildlife temporarily reduced. Natural revegetation to pre-project conditions will require a period of years. Noise from construction operations will cause local disturbance of wildlife in the area. The proposed land treatment site is presently sagebrush community. Alternatives F and G propose to irrigate approximately 620 acres of desert and Alternative H will require 300 acres. This will necessitate the destruction of the existing vegetative cover and wildlife habitat on an estimated square mile and replace it with agricultural cropland. The extent and magnitude of this proposed action will have an adverse impact on the terrestrial communities of the site. This habitat type is not limited to the immediate area and the regional impact of this loss is considered minor.

Irrigation of the land treatment site will recharge groundwater aquifers in the general area and thereby supply phreatophytes with additional groundwater. If this resource is not intercepted by wells, the raising of the groundwater table may alter the plant communities in the vicinity of the site and result in changing natural successional trends within these communities. Changes in groundwater quality near the Spanish Springs site also have the potential for altering the natural vegetation in the vicinity of the treatment site if nutrients or heavy metal regimes change significantly.

The endangered southern bald eagle, American peregrine falcon and other rare and endangered species may utilize the Spanish Springs area as periodic feeding areas and may therefore be adversely affected by the removal of the proposed land treatment site from natural terrestrial productivity. The magnitude of this impact is considered minor due to the relative similarity of the habitats on the site to that of large adjacent areas and because activities of man are pervasive in the area.

The pigeon hawk (= Merlin hawk), and ferruginous hawk, osprey, white-faced ibis, snowy plover, long-billed curlew, burrowing owl, yellow billed cuckoo, spotted bat and Sierra red fox are considered rare and/or endangered in the State of Nevada and have ranges which include major portions of the service area. The removal of terrestrial habitats from natural productivity as a result of land use changes (e.g., land treatment site expanding urban areas) associated with the project will adversely affect these species to a minor degree.

Flora and Fauna - Concepts II and IV

Under Concepts II and IV, the projected phosphate levels in JWPCP effluent for Alternatives B and C (234 lb/day or 2.1 mg/l) and Alternative A (335 lb/day or 3.1 mg/l), are lower than the present average level. The prediction level (R-32) of phosphate in the river at the point of complete effluent mixing is correspondingly lower than the present average for the low flow month of August thus representing a long term beneficial impact on the aquatic biota. It is expected that the slight increase in nitrate level (R-32), would cause a long term adverse impact due to the higher nutrient levels that will occur in the river.

The reduction in phosphate levels projected for Concepts II and IV for the Truckee River are expected to benefit the aquatic ecosystem of the river and Pyramid Lake by lowering the nutrient load and reducing the potential for algal blooms. However, increases in other parameters such as nitrates, BOD, etc. could offset the reduction in phosphorus and result in impacts on aquatic life somewhat more adverse than Concepts I and III due to higher phosphate levels predicted for Concepts II and IV (see Figure 6-11).

The predicted effluent/river mixing concentrations of BOD and TDS for Concepts II and IV (R-32), are slightly higher than present mean August levels and are considered long-term, adverse impacts on the aquatic biota of the Truckee River. The prediction effluent/river mixing temperature is approximately equal to that recommended for summer maximum (M-2). Ammonia concentrations and impacts on aquatic life under Concepts II and IV will be the same as those described for Concepts I and III.

The removal of native vegetation at the land disposal site will constitute a loss of wildlife habitat at this location. The size of the proposed disposal site is unknown at this time.

Flora and Fauna - No Project

The mean BOD of the existing plant effluent is about 8 mg/l (K-1). Without upgrading or expansion, the projected effluent BOD (123 mg/l or 41,000 lb/day) would eventually result in an effluent/river complete mixing BOD of approximately 18 mg/l at a 40 MGD flow. At that same point, river DO would be about 7.7 mg/l, well within acceptable limits for aquatic biota needs. However, predictions (R-32) indicate that, as this effluent/river mixture moves downstream, the BOD will decrease to about 16 mg/l just above Derby Dam while DO will drop to about 5.5 mg/l. Dissolved oxygen would very likely fluctuate as the river flows the remainder of its course due to reaeration occurring at dams and diversion structures; however, the trend indicated is that of continuous DO reduction until water passes into Pyramid Lake.

The phosphate level in the river at the point of mixing would increase from about 1.0 mg/l to about 2.4 mg/l (R-32) which would contribute to gradually increasing algal productivity downstream. During extreme low-flow conditions with summer water temperature increases, such eutrophication could produce extreme consumptive demands upon the

stream's DO tension. Ammonia levels would be increased considerably, and given the above reduction of DO and high natural water temperatures, these combined conditions could cause fish kills. Water quality trends would threaten the existence of the lower Truckee River and Pyramid Lake fishery, including the population of the threatened Lahontan cutthroat trout and Cui-ui lakesucker, and further reduce aquatic faunal diversity at all trophic levels with corresponding increases in pollution-tolerant organisms.

The no action alternative with growth could cause additional problems. Suspended solids in plant effluent (123 mg/l or 41,000 lb/day) would increase nine times above present mean level. The potential for the deposition of solids over the stream bottom in Steamboat Creek and Truckee River will be high, causing suffocation of benthic communities, severe alteration of aquatic habitats, and the covering of fish eggs and spawning beds downstream of the plant outfall.

Projected ammonia (NH_3) levels in the effluent would approach 20 mg/l (6,670 lb/day). Although information is insufficient to accurately predict ammonia concentrations downstream, in view of the projected high level (20 mg/l) before river dilution and a prediction, after river dilution, of pH levels permitting ammonia toxicity (pH 7.5), an adverse and toxic condition in the river is very probable. The amount and rates of un-ionized ammonia oxidation are difficult to predict, but the impact of high un-ionized ammonia levels would probably extend to Derby Dam. EPA Water Quality Criteria (E-27) recommends that un-ionized ammonia (NH_3) not exceed 0.02 mg/l. Un-ionized ammonia levels at Lockwood have been recorded at 0.99 mg/l during February 1975.

Under the no action alternative, with projected growth rates, effluent quality will decrease considerably, causing an adverse impact on aquatic plant communities in Steamboat Creek and the Truckee River which are intolerant to a degradation in water quality. This will result in significant adverse impacts on the fishery of the Truckee River and Pyramid Lake and directly conflict with the U. S. Fish and Wildlife's program to maintain and propagate the threatened Lahontan cutthroat trout and Cui-ui.

No direct impacts on terrestrial ecosystems will result under the no action alternative.

Recreation

As pointed out in Chapter 2, Nevada Department of Fish and Game records indicate that the Truckee River from Stateline to and including Pyramid Lake accommodated 226,000 fisherman days in 1972. The Bureau of Outdoor Recreation estimates that for every hunting and fishing day, there are nine more recreation days expended for other outdoor activities within the Truckee River Basin. Assuming the nine to one ratio, it would appear that as many as 2.25 million recreational visitor days occurred along the Truckee River and at Pyramid Lake in 1972.

Assuming that the ratio of total angler days to total water-oriented recreation visits in the Truckee River Basin and total recreation value are constant, and utilizing the projections from the same source for angler days, in the year 2000 the total water-oriented recreation visits in the Truckee River Basin would be 26,306,000 and the total recreation value during the year 2000 is estimated at $51,257,000. It is probable that the project would affect these forecasts only insofar as the no project alternative would severely limit population growth in the Truckee Meadows area.

Groundwater Hydrology/Quality - Concepts I and III

The groundwater hydrology described in Chapter 3 would be significantly altered by irrigating the 300 to 620 acres proposed within Concepts I or III. Since the crops grown on the irrigated land, plus direct evaporation would likely consume only 2 ft/yr of the proposed 4 ft/yr of irrigation water, the proposed alternatives for these concepts could produce a significant net increase in recharge rates to the groundwater system. A local groundwater mound would develop, centered under the irrigation site, which would tend to add eastward, westward and downward components to the local groundwater flow. Unless it were intercepted by increased pumping from wells in the area, the majority of the additional groundwater would likely be transpired by phreatophytes in the present discharge areas. A small portion of this flow could enter the North Truckee Drain if it is not intercepted. The area covered by near-surface water table conditions would likely expand, thereby creating conditions more suitable to the production of phreatophytes.

The application of digested sludge to land through spray irrigation may also have an impact on groundwater quality. Since the quantity of water applied through spray irrigation would be in excess of what is normally consumed by vegetation,

there would be the tendency to leach soluble nutrients and metals from the upper soil horizons in a downward direction. Coarser soils, such as those at the Spanish Springs Valley site, with high infiltration and percolation water, may permit the wastewater to pass through to the groundwater so rapidly that there is sufficient time for complete water quality renovation to occur (E-35). This can be prevented by adjusting the amount of nutrients added to equal the amount harvested in the plants, volatized into the air, and retained within the soil (B-27). Nitrogen is frequently the nutrient that limits the rate of waste that can be applied to land areas. This is especially true for sandy soils, since nitrogen is highly soluble and found in relatively high concentrations in municipal sewage sludge and effluent (I-5, E-28).

There is not enough information available to date to determine the maximum amount of nitrogen that could be added annually per acre before leaching of nitrates would occur. Since implementation of the irrigation concept would have the effect of increasing the safe yield of the Spanish Springs Valley aquifer by roughly 1,000 acre-ft/yr, maintaining good quality, potable water in this aquifer is important.

Based on recommended application rates for digested sludge and estimated nutrient loading rates (see Tables 6-P and 6-Q), the proposed nutrient loading rates anticipated in the facilities plan are too high. Available information suggests that the proposed Alternatives F, G and H would recharge the Spanish Springs Valley aquifer with water which would have a nitrate as N concentration in excess of the 10 mg/liter limit recommended by the USEPA (E-24) for human consumption. In order to maintain groundwater quality within the 10 mg/liter nitrate limit, application of effluent over a land area three to four times larger in size than that originally contemplated may be required. However, because these estimates are based on other land treatment operations and no "on-site" data is available, a field study is necessary to determine the maximum safe annual nutrient loading rate at the proposed land reclamation site.

As described in Alternative F, the sub-surface leaching of the PhoStrip effluent during the winter months would have an additional impact on the groundwater quality. Although details of this program have not been finalized, it can be assumed that such a program would remove very little

TABLE 6-P

RECOMMENDED APPLICATION RATES FOR DIGESTED SLUDGE

Soil Type	Crop	Location Testing	Recommended Loading Rate (lbs. N/acre/yr)
Clay loam	Corn	Southern California	200
ND[c]	ND	ND	170-200
ND	Non-Leguminous	Illinois	680-1020
Clays	ND	Maryland	11,000[a]
Sandy	Corn	Illinois	150-250
Sandy	Forage	Boulder, Colorado	<1,300[b]

NOTES: [a] Single application mixed into soils did not cause leaching of nitrates.

[b] Using effluent rather than sludge, irrigating at 24 acre-ft/yr, the resulting leachate contained ∿ 10 mg/l nitrogen; at lower irrigation rates with some nitrogen loading rate, the nitrogen concentration in leachate would be higher.

[c] ND - No data given in publication.

Source: (I-5, H-15, E-25, H-16, D-8, P-6)

TABLE 6-Q

ESTIMATED NUTRIENT LOADING RATES - ALTERNATIVES F, G, AND H[a]

Nutrient	Alternative	Applied Concentration (mg/l)	Loading Rate (lbs/acre/yr)
Nitrogen (as N)	F	68	1779
	G	92	1459
	H	200	2230
Phosphorus (as P)	F	46 (dissolved)	1199 (dissolved)
	G	76 (44 dissolved, (32 precipitated)	1199 (699 dissolved, (500 precipitated)
	H	222 (precipitated)	2477 (precipitated)

NOTES: (a) Estimates based on typical concentratons of nutrients in a municipal sewage sludge

Source: (E-20, K-1, E-21, E-22)

nitrogen from the applied water. This implies that the groundwater would be recharged with water containing a high concentration of nitrogen, and therefore would not be considered safe for human consumption. Since the quantities of water involved are relatively high, (2,500 acre-ft/yr maximum), this alternative would have a significant adverse effect on the groundwater quality in Spanish Springs Valley.

Based on chemical analysis (Bureau of Mines, Reno, Nevada) of two samples of the digested sludge currently being produced at the Reno-Sparks JWPCP (see Table 6-R), it appears that the concentrations of certain metals added to the soil under Alternatives F, G and H would be relatively high. Problems resulting from accumulations of metals in soils due to application of sewage sludge are usually related to uptake and accumulation by plants and the utilization of these plants for food by animals possibly including man. The potential for heavy metal contamination of groundwater varies according to several factors, including amount of clay in the soil, pH and the presence of organic material. The Illinois Advisory Committee on Sludge and Wastewater Utilization on Agricultural Land stated that "..although there are no conclusive field data existing in the literature, researchers suggest that potential for the trace element pollution of groundwater is low" (I-5); however, they went on to say that "data available at the present time dictates the need to exercise caution with respect to heavy metals..." (I-5). The concensus of several investigators is that copper, nickel and zinc are likely to be toxic to plants when excessive available quantities are present in the soil (B-37). Other metals known to be most toxic to plants, particularly boron and cadmium, were not detected in JWPCP digested sludge sample analysis (see Table 6-R). General recommendations for copper, nickel and zinc concentrations in dried digested sewage sludge that should not be exceeded in land application are also given in Table 6-R. It should be noted that copper and zinc concentrations in the two JWPCP sludge samples indicate that current levels of these metals have reached or exceeded the recommendations for maximum concentration levels in sludge to be used in land application.

Therefore, even though the buildup of metals in the soils resulting from Alternatives F, G, and H, may have essentially no impact on the groundwater system, no conclusive statement or recommendation can be made until a site-specific study has been made to determine heavy metal removal by vegetation and leaching.

TABLE 6-R

DIGESTED SLUDGE SAMPLE ANALYSIS AND RECOMMENDED MAXIMUM CONCENTRATIONS OF SELECTED METALS FOR LAND APPLICATION[a]

Parameter	Sample 1 (ppm-dry weight)	Sample 2 (ppm-dry weight)	Selected Heavy Metal Maximum Concentrations in Dried Sludge (ppm)
Lead	473	372	--
Copper	1,000	854	750 to 1,000
Zinc	2,091	1,818	1,500 to 2,000
Nickel	77	62	<100 to 200
Chromium	245	200	--
Iron	10,000	8,909	--
Manganese	209	191	--
Silver	218	191	--
Magnesium	7,818	7,273	--
Calcium	58,182	50,909	--

NOTES: (a) Samples taken February 9, 1976; none of the following parameters were detected by a qualitative spectrographic procedure: Cobalt, Cadmium, Antimony, Barium, Beryllium, Tungsten, Bismuth, Zirconium, Gold, Hafnium, Nobellium, Platinum, Tantalum, Vanadium and Molybdenum.

Source: (I-4, E-36, M-10, S-31)

Under a no growth situation (i.e., population remains at 1976 levels), the flow from the upgraded treatment plant would be approximately 20 MGD or 22,400 acre-ft/yr. Assuming the land treatment site would be 150 acres (as proposed for initial irrigation if this alternative is selected), and an average liquid application rate of 5.5 acre-ft/yr would be required to grow an agricultural crop (S-7), a total of approximately 825 acre-ft/yr would be required for the Spanish Springs land reclamation project. Any growth rate that may occur above 1976 levels will require additional acreage and irrigation water roughly proportional to the population increase.

Impacts of the land treatment proposal related to groundwater quality are dependent upon loading rates, soil conditions, groundwater hydrology, etc. and cannot be considered separately from these other relevant parameters. Likewise, the lack of detailed plans for the operation of the proposed site makes discussion of impacts difficult. The following paragraphs summarize problems associated with such programs in general terms, based upon the limited information available in the facilities plan.

Analysis of nitrogen averages for domestic sewage indicates that the amount of nitrogen to be applied to the land annually is approximately 1,779 lbs/acre/yr under Alternative F; 1,459 lbs/acre/yr under Alternative G; and 2,230 lbs/acre/yr under Alternative H (K-1). Generally, most crop plants can utilize between 50 and 200 pounds of elemental nitrogen per acre annually depending on the type of crop grown (R-33). Forage crops have been reported to take up a large percentage of nitrogen. Maximum nitrogen uptake has been reported at 480 to 600 lbs/acre/yr for coastal Bermuda grass, with a minimum figure of 77 to 126 lbs/acre/yr for red clover. Nitrogen uptake by field crops is a comparatively smaller amount than is estimated for forage crops. Nitrogen uptake by field crops ranges from 155 lbs/acre/yr for corn to 50 to 76 lbs/acre/yr for wheat (P-6). These data suggest that the land treatment site may have to be expanded beyond the proposed acreage. However, a detailed study of nitrogen loading must be completed before further conclusions can be drawn.

In the intermediate time range (15 years for sandy soils), phosphorus may govern nutrient loading rates. It has been recommended that after 5 years, the phosphorus content in the soil be monitored, and sludge application temporarily suspended if the phosphorus content in sandy soil exceeds

400 pounds per acre (I-5). Loading rates proposed for phosphorus on the land treatment site in Concept I are 1,199 lbs/acre/yr dissolved phosphorus for Alternative F; 1,199 lbs/acre/yr (699 dissolved, 500 precipitated) for Alternative G; and 2,477 lbs/acre/yr precipitated phosphorus under Alternative H (K-1). The phosphorus application rate appears to be relatively high compared to current recommendations (I-5). Over a long period of time, the accumulation of phosphorus may interfere with crop growth. Generally excess accumulations of phosphorus reduce the availability of other plant micronutrients and result in nutrient imbalance in the plant rather than toxic levels of phosphorus in the crop (P-6, R-33).

The land requirements for the land treatment program are difficult to determine at this time. They are dependent upon many factors, but primarily upon the nitrogen application rate. If a reasonable rate is used in the calculations, for example, 400 pounds per acre per year, the land requirement for the 20 MGD flow would be approximately 775 acres, with a doubling to 1550 acres at 40 MGD. However, actual safe loading rates may be considerably lower or higher and cannot be accurately determined with existing data.

In order to irrigate 1550 acres and maintain a maximum nitrogen loading rate of 400 pounds/acre/yr, supplemental, relatively nitrogen free water (approximately 5000 acre feet/yr) will be needed to irrigate the treatment site with 4 acre-feet/yr required to grow an agricultural crop. The possible sources of this water include groundwater at Spanish Springs, Orr Ditch, or the Truckee River.

Sludge and effluent transported via the pipeline to Spanish Springs need not all be immediately applied to the land. Initially the proposed acreage (620 acres for F and G, and 300 acres for H) could be spray irrigated with nitrogen loading rates approximating 400 pounds per acre per year and the remaining sludge stored temporarily. A sludge drying and public give-away program may significantly reduce the volume of sludge requiring storage. During the initial operation, groundwater quality, uptake and removal, and soil analyses will provide long range operating plan service and determine the need for additional land and supplementary irrigation water, if any. Regardless of the additional requirements or actual application rates, groundwater monitoring should be conducted periodically throughout the life of the project.

Groundwater Hydrology/Quality - Concepts II, IV and No Project

There are no major groundwater impacts associated with the remaining alternatives for the JWPCP except as the secondary result of sludge disposal operations. While such impacts are potentially long term, they are subject to design solution, details of which are not yet available for assessment.

The no project alternative has an added impact of continuing the current upstream groundwater pollution potential since no interception of individual sewerage system outflows would be accomplished.

Comparison of Treatment Concept Impacts

The foregoing impact assessment is summarized for reader convenience in Table 6-S and Figure 6-12 which display the comparative impacts of each alternative for all environmental parameters. The relative importance column associated with individual impacts is intended as a guide in determining the desirable alternate. Items of major importance are considered sources of considerable environmental impact. Items of equal importance are unavoidable impacts associated with all alternatives. Minor items should not require revision of the alternate nor lead to significant environmental impacts. Generally, Concepts I and III have similar impact patterns (Figure 6-12); II and IV have similar impact patterns. This is to be expected from the grouping of design configuration on the four concepts. Although the difference in impacts among the four concepts is not substantial, Concepts I and III involve slightly greater short term impacts, and somewhat reduced long term impacts in comparison to Concepts II and IV.

Secondary Impacts of No Treatment Plant Expansion

Objective evaluation of a no action decision in regard to treatment plant expansion requires the establishment of several assumptions:

1) Projected design population will be reached.

2) Sewage treatment for new developments will be by individual or local systems.

TABLE 6-Sa

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY

Area of Impact		Impact Source	Relative Importance
Topographic	Concept I	1. Reclamation of land use for sludge drying	Equal
		2. Excavation for transmission lines to Spanish Springs	Minor
		3. Drainage and flood control measures at irrigation site	Minor
	Concept II	1. Reclamation of land used for sludge drying	Equal
		2. 60,000 lbs/day of dried sludge for landfill	Minor
	Concept III	1. Reclamation of land used for sludge drying	Equal
		2. Excavation for transmission lines to Spanish Springs	Minor
		3. Drainage and flood control measures at irrigation site	Minor
	Concept IV	1. Reclamation of land used for sludge drying	Equal
		2. 60,000 lbs/day of dried sludge for landfill	Minor
Scenic-Aesthetic	Concept I	1. Construction operations for transmission line	Minor
		2. Change in irrigation site land use to agriculture	Minor
	Concept II	1. Daily sludge disposal activity	Major
		2. Possible incinerator fumes	Major
	Concept III	1. Construction operations for transmission line	Minor
		2. Change in irrigation site land use to agriculture	Minor
	Concept IV	1. Daily sludge disposal activity	Major
		2. Possible incinerator fumes	Major

TABLE 6-Sb

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Archaeologic	Concept I	1. 37 sites in irrigation area 2. 30 sites along transmission alignment	Major
	Concept II	1. Not known	
	Concept III	1. 37 sites in irrigation area 2. 30 sites along transmission alignment	Major
	Concept IV	1. Not known	
Soils Geology Seismicity	Concept I	1. Spillage or rupture of tanks or lines may result in contamination 2. Contamination risks at irrigation site if leachates are not contained	
	Concept II	1. Leaching and surface runoff contamination risks from disposal stockpile site	
	Concept III	1. Spillage or rupture of tanks or lines may result in contamination	
	Concept IV	1. Leaching and surface runoff contamination risks from disposal stockpile site	
Climate and Air Quality	Concept I	1. Increased suspended particles during construction	Equal
	Concept II	1. Incineration would yield 5,300 lbs/day uncontrolled particulate emissions	Major
		2. Increased suspended particles during construction	Equal
		3. Increased suspended particles during sludge disposal	Minor

TABLE 6-Sc

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Climate and Air Quality	Concept III	1. Increased suspended particles during construction	Equal
	Concept IV	1. Incineration would yield 5,300 lbs/day uncontrolled particulate emissions	Major
		2. Increased suspended particles during construction	Equal
		3. Increased suspended particles during sludge disposal	Minor
Acoustics	Concept I	1. Short term noise increase during plant expansion	Equal
		2. Short term noise increase during transmission line construction	Minor
	Concept II	1. Short term noise increase during plant expansion	Equal
		2. Long term noise from disposal activity	Major
	Concept III	1. Short term noise increase during plant expansion	Equal
		2. Short term noise increase during transmission line construction	Minor
	Concept IV	1. Short term noise increase during plant expansion	Equal
		2. Long term noise from disposal activity	Major
Urban Systems Transportation	Concept I	1. Transport of construction material	Minor
		2. Driver distraction along Spanish Springs Road	Minor
		3. Possible interference with east-west interstate traffic during construction	Minor

TABLE 6-Sd

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Urban Systems Transportation	Concept II	1. Transport of construction material	Minor
		2. Dried sludge disposal activity	Minor
	Concept III	1.	
	Concept IV	1.	
Solid Waste	Concept I	1. Construction wastes	Minor
	Concept II	1. Disposal of dried sludge	Minor
		2. Construction wastes	Minor
	Concept III	1. Construction waste	Minor
	Concept IV	1. Disposal of dried sludge	Minor
		2. Construction wastes	Minor
Water Supply	Concept I	1. Export of water to Spanish Springs, 5.4 MGD to 0.7 MGD	Minor
	Concept II	1. Return of treated effluent to Truckee River	Minor
	Concept III	1. Export of water to Spanish Springs, 5.4 MGD to 0.7 MGD	Minor
	Concept IV	1. Return of treated effluent to Truckee River	Minor
Energy Supply	Concept I	1. 11.75×10^6 kwh - 27.95×10^6 kwh/yr	Equal
	Concept II	1. 9.64×10^6 kwh - 168.6×10^6 kwh/year	Major
	Concept III	1. 37.3×10^6 - 61.8×10^6 kwh	Equal

TABLE 6-Se

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Energy Supply	Concept IV	1. 35.19×10^6 - 58.64 $\times 10^6$ kwh	Equal
Economics and Employment	Concept. I	1. Capital cost $22.5 - 29.7 (million dollars)	Equal
		2. Operation and maintenance $.8 - 1.2 (million dollars)	Equal
		3. Personnel requirements 26-30	Equal
	Concept II	1. Capital cost $14.1 - 21.5 (million dollars)	Equal
		2. Operation and maintenance $1.1 - 1.7 (million dollars)	Equal
		3. Personnel requirements 28-36	Equal
	Concept III	1. Capital cost $20.4 - 24.3 (million dollars)	Equal
		2. Operation and maintenance $1.2 - 5.1 (million dollars)	Minor
		3. Personnel requirements 28-32	
	Concept IV	1. Capital cost $12.0 - 13.2 (million dollars)	Minor
		2. Operation and maintenance $1.5 - 5.6 (million dollars)	Minor
		3. Personnel requirements 33-36	Equal
Surface Water Hydrology	Concept I	1. Loss of 1200-6000 acre feet of water resulting from export to Spanish Springs	Minor
		2. Some water used for disposal may enter the North Truckee Drain and return to river	Minor
		3. Return flow to river - 90 to 97 percent	Equal

TABLE 6-Sf

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
	Concept II	1. Return flow to river - 99%	Equal
		2. 11 - 220 acre feet of water/ year would remain in sludge	Minor
	Concept III	1. Loss of 1200 - 6000 acre feet of water resulting from export to Spanish Springs	Minor
		2. Some water used for disposal may enter the North Truckee Drain and return to river	Minor
		3. Return flow to river - 90 to 97%	Equal
	Concept IV	1. Return flow to river - 99%	Equal
		2. 11 - 220 acre feet of water/ year would remain in sludge	Minor
Surface Water Quality	Concept I & III	1. Nitrate and BOD concentration increase	Equal
		2. 10 to 20% increase in dissolved solids	Equal
		3. Chloride level increase of 10% (detrimental to fishery of river)	Equal
		4. May occasionally violate state phosphate level standards	Minor
		5. Increase in ammonia concentration	Equal
	Concept II & IV	1. Will occasionally violate state phosphate level standards	Major
		2. Nitrate and BOD concentration increase	Equal
		3. 10 to 20% increase in dissolved solids	Equal
		4. Chloride level increase	Equal
		5. Ammonia concentration increase	Equal

TABLE 6-Sg

DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Flora and Fauna	Concept I & III	1. Increase in nitrate concentrations by 50%	Equal
		2. Addition of nutrients	Equal
		3. Increased ammonia concentration with 40 MGD operation	Major
		4. Annual water loss from irrigation	Minor
		5. Increased sediment loads during construction of transmission lines	Minor
		6. Addition of nutrients to Spanish Springs Road through groundwater	Major
		7. Clearing of 5 acres of land adjacent to treatment plant	Minor
		8. Construction of pipeline across Truckee River	Major
		9. Temporary destruction of native vegetation along pipeline corridor	Minor
	Concept II & IV	1. Increase in nutrient levels	Major
		2. Concentration of BOD and TDS	Equal
		3. Increased ammonia concentration with 40 MGD operation	Major
		4. Removal of native vegation at unnamed disposal site	Minor
		5. Increase in phosphate level at point of mixing from 1 $mg/_1$ to 2.4 $mg/_1$	Equal
Groundwater Hydrology & Quality	Concept I & III	1. Increase in recharge rates at irrigation site to 900 $\frac{ac.ft.}{yr}$ to 3000 $\frac{ac.ft.}{yr}$	
		2. Add to groundwater movement to the east and west, as well as down	

TABLE 6-Sh

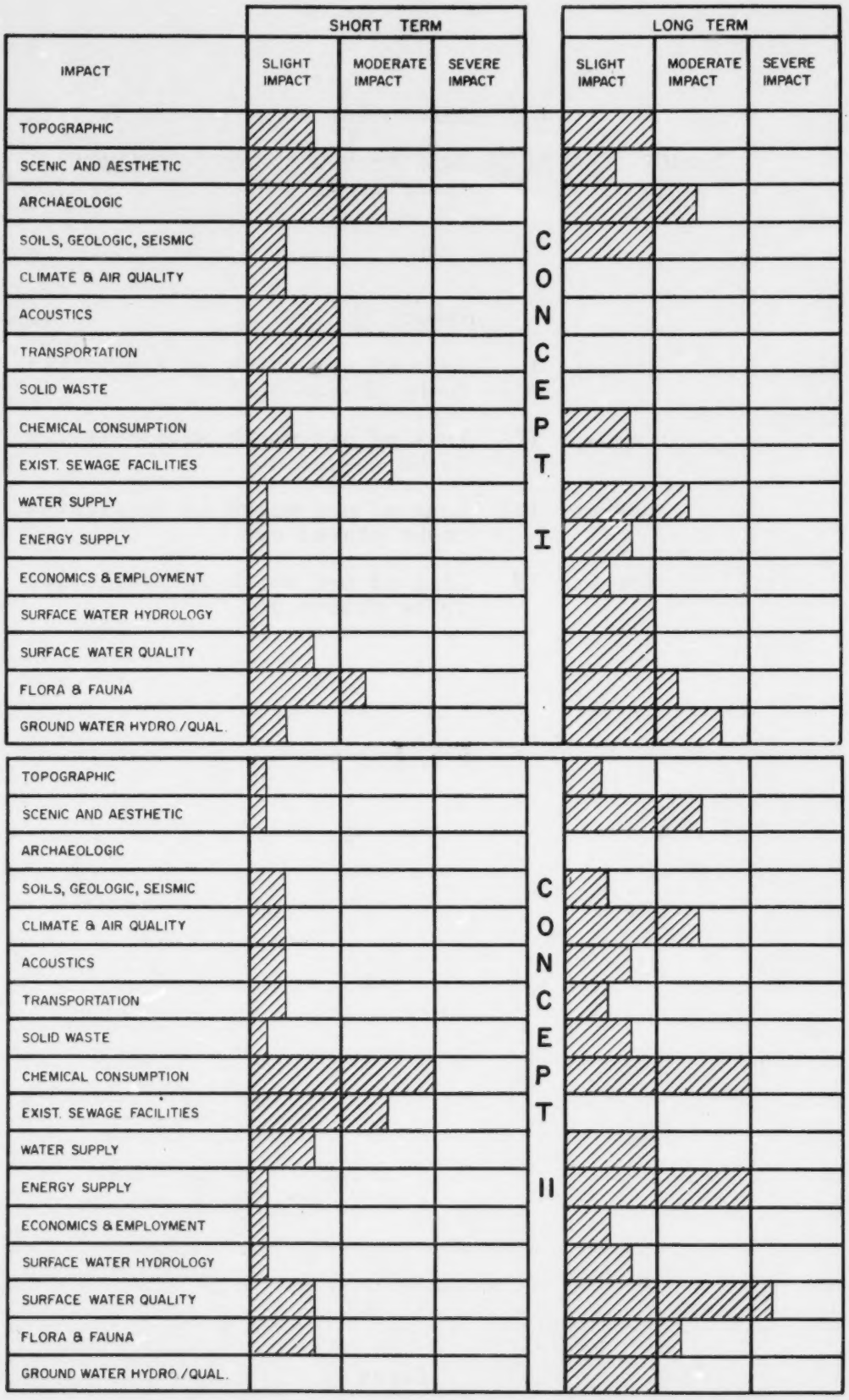
DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
		3. Some additional groundwater may reach North Truckee Drain 4. Soluble nitrogen entering water table 5. Heavy metals entering groundwater	
	Concept II & IV	1. Sludge landfill site	
Resource Consumption	Concept I	1. 1600 lbs/day chlorine 2. 5787-12625 lb/day lime 3. 0 lb/day ferric chloride 4. 0 lb/day alum	Equal
	Concept II	1. 1600 lbs/day chlorine 2. 5512-66850 lb/day lime 3. 1775-1836 lb/day ferric chloride 4. 10,016-53,425 lb/day alum	Equal
	Concept III	1. 1600 lbs/day chlorine 2. 5787-12625 lb/day lime 3. 0 lb/day ferric chloride 4. 0 lb/day alum 5. 66,850 lb/day oxygen 6. 25200 lb/day activated carbon	Equal
	Concept IV	1. 1600 lbs/day chloride 2. 5512-19030 lb/day lime 3. 1775-1836 lb/day ferric chloride 4. 53,425 lb/day alum 5. 69041 lb/day oxygen 6. 25205 lb/day activated carbon	Equal

TABLE 6-Si

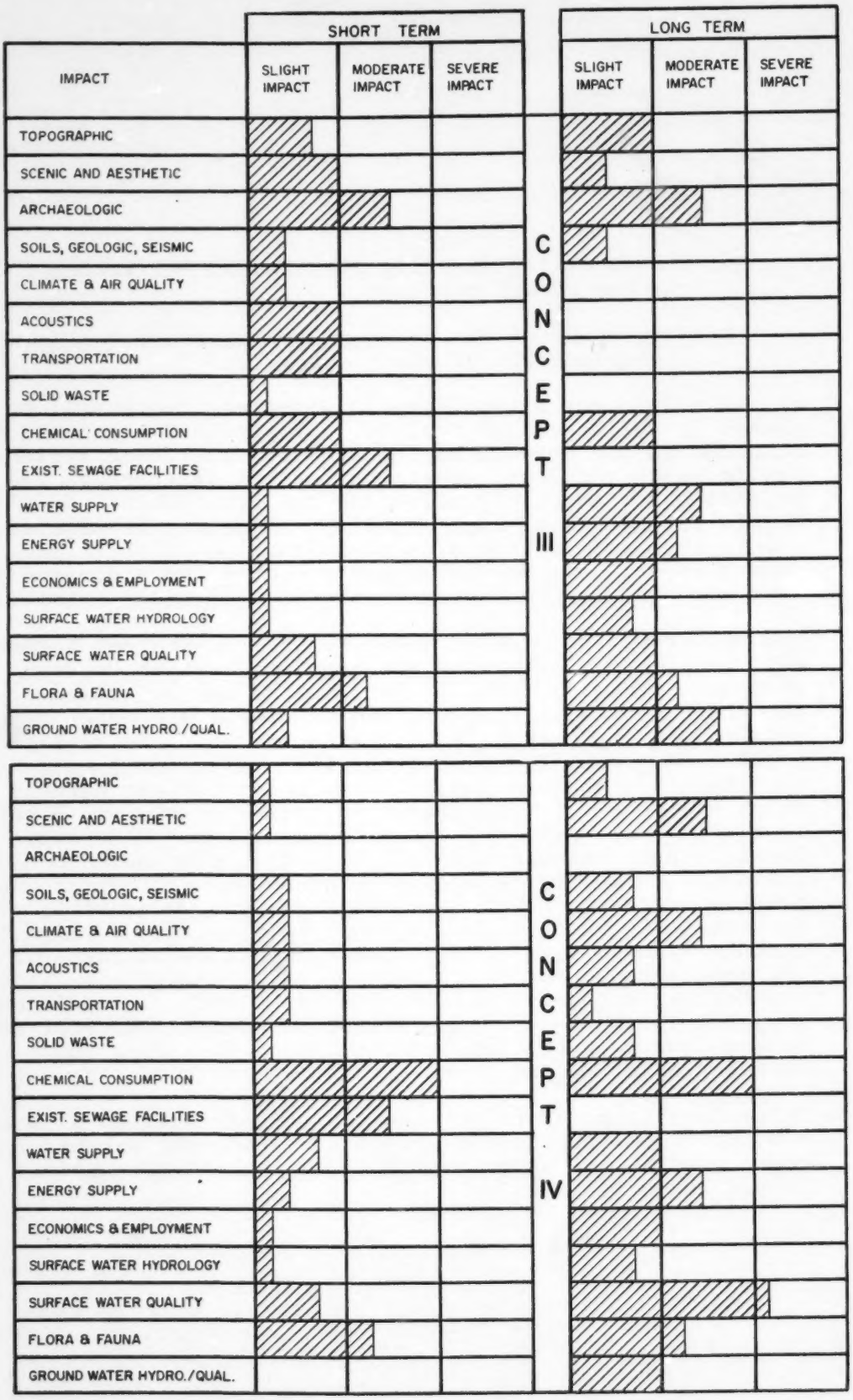
DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Existing Sewage Facilities	Concept I	Loss of net worth in facilities to be phased out	Equal
	Concept II	Loss of net worth in facilities to be phased out	Equal
	Concept III	Loss of net worth in facilities to be phased out	Equal
	Concept IV	Loss of net worth in facilities to be phased out	Equal



DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY AND COMPARISON

Figure 6-12-A



DIRECT IMPACTS OF TREATMENT CONCEPTS - SUMMARY AND COMPARISON

Figure 6-12-B

3) Flows at the existing plant would be limited to the 20 MGD capacity.

4) Upgrading of the treatment process will occur independently of plant expansion.

If the no project alternative is selected, there will be little change in surface water quality. If population growth continues to occur in the absence of the project, increased reliance on septic tanks and local treatment facilities increase the potential for adversely affecting the groundwater and ultimately Truckee River water quality. However, if population growth and urbanization slow to a fraction of that forecasted, growth is unlikely in the economic sector and a decline in economic activity in Washoe County is a distinct possibility.

The downstream vegetative impact of the no project alternative will vary in proportion to the population which occurs. If phosphate removal, only, is implemented and no growth occurs, phosphate levels will be reduced and other parameter levels will remain approximately at current levels. If significant population growth does occur and the hydraulic capacity is not improved, serious consequences to downstream aquatic fauna will occur. Significant increases in BOD would result in distinct DO sags downstream to Derby Dam. Phosphate levels would increase significantly and contribute to gradually increasing algal activity downstream, which could produce extreme consumptive demands on the DO tension. This, in combination with higher ammonia levels could combine to produce fish kills. Water quality trends would threaten the existence of the lower Truckee and Pyramid Lake fishery and further reduce aquatic faunal diversity. In addition, suspended solids would increase significantly above present levels causing potential suffocation of fish eggs and degradation of spawning beds downstream of the plant outfall.

Other impacts would be similar to those forecasted with the project unless population growth is slowed and urbanization reduced under the no project alternative. These impacts are displayed in Table 6-T.

TABLE 6-Ta

SECONDARY IMPACTS OF NO TREATMENT PLANT EXPANSION - SUMMARY

Area of Impact	Impact Source
Topographic	1. New developments requiring individual or local treatment systems would locate outside Reno & Sparks corporate limits, and thus consume more open space.
Scenic-Aesthetic	1. Developments consuming more open space will change aesthetics of affected areas. 2. New developments will require individual or local treatment plants which will be noticeable. 3. Some lands designated for rehabilitation within corporate limits would remain in an under-developed state.
Transportation	1. Trip lengths may be increased as new industries are located outside of existing developed areas and residential urbanization spreads.
Water Supply & Quality	1. Quality control is more difficult to monitor with increased individual and local systems and could potentially contribute to water quality problems whose nature would depend on discharge characteristics, methods and type of treatment process employed. 2. Should the above occur higher treatment levels will be required for domestic water sources.
Energy Supply	1. Energy consumption for the existing plant plus energy consumed in operation of local treatment systems would be greater than that consumed for one 40 MGD plant.
Economics	1. Property tax revenues would be lost if higher percentages of new development is forced outside of corporate boundaries. 2. Total cost for local treatment plants with total combined capacity of 20 MGD would exceed cost of JWPCP expansion to 40 MGD.

TABLE 6-Tb

SECONDARY IMPACTS OF NO TREATMENT PLANT EXPANSION - SUMMARY
(continued)

Area of Impact	Impact Source
Soils, Geology & Seismicity	1. Increased number of local plants would raise probability of raw sewage escape should an earthquake occur. 2. Increased sub-surface and surface treatment methods would present greater soil contaminatio possibilities.
Surface Water Hydrology	1. It is likely that less water would be returned to water courses with scattered local systems.
Resource Consumption	1. More materials would be required to construct several local plants.
Reclamation and Reuse	1. Not practical.

IMPACTS OF CROSS-TOWN SEWER ALTERNATIVES ON THE ROUTE ENVIRONS

Topography

Cross-Town Sewer Alternative AB is proposed to be constructed in existing street right of way and will have no long term topographic effect. The primary impact of this project will occur during construction. Topographic impacts will result from excavation for the pipeline trench. This impact will be limited to a relatively narrow but long corridor. Excess material removed from the construction site will be disposed of in other areas. Following construction, with the exception of some potential excavation for maintenance, there will be no other long term impacts on topography.

The proposed CD alignment is entirely in existing streets from Kirman Avenue to Arlington Avenue where it enters and crosses Riverside Park. Topographic impacts occur in this area, and are considered short term and construction related. Topographic alterations will be trenching through the parkway, and modifications related to construction of one river crossing. Short term construction impacts associated with the CD alignment will be similar to those expected for the AB alternate.

As illustrated in Chapter 5, sub-alternates have been proposed to continue the pipeline westerly from Riverside Drive and Jones Street. Construction related topographic impacts occur in Riverside Drive and consist only of the short term trenching operations.

Sub-alternate (J), also in existing streets, has no long term topographic impacts. Construction related, short term impacts will occur in Jones Street, west of Riverside Drive, and consist only of trenching operations.

There will be no short or long term topographic effects if no project is undertaken.

Scenic and Aesthetic Characteristics

Scenic and aesthetic impacts are also limited to the short term impact of construction for both alternatives. Residential and commercial uses, including the casinos, will be inconvenienced by equipment opening trenches, laying pipe, backfilling, compacting and paving the construction area. It is important to consider the function of Riverside Drive (sub-alternate) as Reno's Scenic Drive. Tourists and

residents follow this publicized 10 to 12 mile route through rural, residential and downtown areas past many important local visual features. The construction impacts will interrupt traffic on this route for a short time and interfere with views of the river and many older homes.

Recreation

The AB route is proposed to be constructed adjacent to the Arlington Avenue Bridges and across Wingfield Park in the City of Reno right-of-way. Wingfield Park is an island formed as the Truckee River splits upstream and rejoins downstream of the park. This park is near downtown Reno and provides important natural visual relief and passive recreation near the city's urban core. Impacts on this park would be limited to short term construction activity; noise, dust and trenching would interfere with the recreational features of this park. Along the north side of the Truckee River on Riverside Drive from Arlington Avenue to Washington Street, this route would parallel a linear park. In the short term, the construction process will similarly impact this park and interrupt the pedestrian access across Riverside Drive to the park. There will be no long term impact on recreation.

Either proposed alternate interceptor route will pass through the casino area south of the Truckee River. Noise and construction activity (barriers, trenches, etc.) may discourage vehicle and pedestrian movement in this area and may result in temporary loss of patronage in these recreation facilities. There would be no long term impact on the recreation potential of this area.

The CD route would also pass through the downtown gambling area and a small park. Riverside Park is separated from the Truckee River by Island Avenue and offers active recreation and play fields. This park is served by a loop street system which would be disrupted by construction. Impacts on the linear landscaped area north of the Truckee would be minimized by this alternative because of its route which crosses under the river well above Arlington Avenue to intercept Riverside Drive. There would be no long term impact on recreation.

If no construction is undertaken, the short term interruption of existing recreation opportunities would be avoided.

Archaeologic Resources

As previously mentioned in Chapter 2, sites within the City of Reno have previously been destroyed or made inaccessible by past development and, consequently, no archaeologic impact is foreseen for the Cross-Town Sewer construction or, for that matter, for the no project alternative.

Pipeline excavation may uncover subsurface archaeologic and historic resources. If this occurs, an archaeologist should perform a field survey to assess the resource and recommend appropriate mitigating action.

Soils, Geology and Seismicity

Excavations for the Cross-Town Interceptor will create vertical trenches in granular soils which will be subject to erosion and caving. Trench excavations will require shoring of trench walls or 1:1 slide slopes. Caving of trench wall is likely to be more serious in areas of high groundwater and dewatering will be required. There is the possibility of damage to adjacent structures including utility lines from slope failures related to trench excavation. In areas where the pipeline will cross the Truckee River, the line must be deep enough to avoid exposure by downcutting or scour by river action. Dewatering and shoring may be necessary or installation of the line by either horizontal drilling and/or jacking may be required. In general, the material from the trench will be suitable for backfill; however, large size material should be excluded. The oversize material should be removed and disposed of in suitable areas. If select material is required, it may be necessary to utilize quarry facilities; however, screening facilities will be needed. Erosion of slopes adjacent to the Truckee River will require rip-rap slope protection. Long term impacts of Cross-Town Sewer installation may include:

1) Contamination of soil due to accidental rupture or break in the sewer line.

2) Exposure of sewer line under the Truckee River due to scour.

3) Indirect impact on mineral resources, that is, increased sewer facilities will accommodate urban development which could encroach on areas of potential mineral resources and prevent future exploitation.

4) Possible damage to the sewer line from landslides near Mogul.

5) Possibility of damage to sewer lines due to surface ground rupture from possible active fault displacement.

6) Ground freezing, which will affect sewage flows unless the lines are well buried or insulated.

All construction alternates and sub-alternates will be subjected to the same seismic risks. The actual performance of individual sections of pipe in an earthquake may depend on several dynamic factors such as earthquake magnitude and displacements. Possible damage to the sewer line from the effects or earthquake ground shaking could be caused by the following:

1) Surface cracks from earth lurching in weak soils, particularly in locations close to river banks. Mitigation would include a reasonable setback from the top of bank.

2) Possible surface settlement from liquefaction and/or differential compaction or densification. These conditions could be identified by site investigations including test borings. Piping systems should be designed to withstand a reasonable degree of movement by incorporating flexible couplings.

Geology underlying the pipelines consists of stream and valley alluvium with occasional large boulders. Groundwater is relatively high and will present the need for dewatering on portions of the routes.

There are no direct soils, geologic or seismic impacts of no action. However, the currently overloaded trunk sewers would remain as a significant source of groundwater and surface pollution in the event of failure under seismic stress.

Hydrology/Water Quality

There are no primary impacts on surface or groundwater hydrology associated with the construction of the Cross-Town Sewer. Adverse impacts on Truckee River water quality will be observed

during construction of this interceptor. These major short term impacts will be associated with the river crossings near Arlington Avenue. During construction, short term, adverse impacts will result from increased turbidity and suspended solids. However, these impacts should affect a relatively small length of stream because the sand and gravel are the major constituents of the river bottom.

The long term water quality impacts are beneficial in that the Cross-Town Sewer will eliminate the possibility of surface discharge from over-loaded sewer mains as an essential element of the City of Reno Master Sewerage Plan.

In the case of no action, short term construction impacts at river crossings would be avoided but long term protection of surface water quality would not be provided.

Flora and Fauna

The damage to aquatic biota from sediment loading as a result of river crossing construction activities was described previously under Alternate AB. Since the line of crossing for Alternate AB is more nearly perpendicular to the river branches than that for Alternate CD, the combined construction disturbance to river substrate and exposure of silt to water transport for Alternate AB would be less than that for Alternate CD. If construction activities are closely controlled to minimize sediment loading in the river, Alternate AB impacts would be short term and adverse, but minor.

The line of crossing in Alternate CD is from the south bank of the Truckee River (about one-tenth mile upstream of Wingfield Park) to the north bank at an approximate 45°-angle. This represents greater bottom disturbance, construction time, and water quality/aquatic biota disruption than the perpendicular crossing proposed under Alternate AB. The impacts on flora and fauna will be short term and minor, though greater for Alternate CD than Alternate AB.

Floodplain vegetation at the crossing site will be destroyed and its value as wildlife habitat diminished until revegetation occurs. The magnitude of this impact is considered minor and short term.

All of the above impacts are avoided with the no action alternative.

Climate and Air Quality

The construction of the Cross-Town Sewer under all alternatives will cause local increases in suspended particulates along the pipeline route due to the earthmoving and construction-related traffic. Construction vehicles will emit pollutants associated with internal combustion engines. These adverse impacts are considered minor, short term effects on the local air quality. There will be no impacts on local climate.

The no action alternative has no effect on climate or air quality.

Acoustics

The noise created by construction activity will temporarily increase ambient noise levels in the central business district to ranges between 85 and 105 dBA, at 50 feet from noise source. There will be no long term increase in noise levels. If no construction is undertaken then no acoustic impact is involved.

Land Use

The primary purpose of the proposed Cross-Town Sewer (all construction alternatives) is to relieve the present insufficient capacity of the existing North Truckee Meadows Interceptor, which provides service to downtown Reno and to southwest, northwest and west Reno. Although northwest and west Reno are within the water service area of the Sierra Pacific Power Company, and are even now subject to urbanization pressures, the existing deficient treatment plant as well as overloaded sewers in central Reno are effectively preventing urban growth in these sewer service zones (K-1). This situation would continue under the no action alternative.

Alternatively, a situation of treatment plant expansion (to the 40 MGD capacity) without benefit of construction of a new Cross-Town Interceptor would have the impact of accommodating urbanization but forcing the storage of sewage in the existing Cross-Town Sewer with the adverse risk of surface discharge due to overload.

A third improvements scenario, involving both construction of the proposed Cross-Town Interceptor and expansion of treatment capability to 40 MGD, would permit new development otherwise constricted by capacity insufficiencies. Particularly benefitted would be the downtown, high-intensity use area of Reno,

which area, without both treatment plant and sewerage improvements, is severely constrained in terms of future urban development (K-1).

Expansion of treatment and collection facilities would enable urbanization to occur to the limit of the Cross-Town Sewer Zone's design population. However, other factors, such as public policy, transportation planning, zoning, and environmental constraints will likely operate as the ultimate determinants of the Cross-Town Service Zone's future urbanization. Insofar as sewer/treatment improvements accommodate the service zone's existing growth potential, urbanization would involve the conversion of land uses from agricultural and ranching to residential, commercial, industrial, and various public uses.

Alternate AB traverses Wingfield Park, and so requires disruption of normal park uses during the period of construction. Use patterns would not be permanently altered as a result of construction dislocations.

The route of Alternate CD travels through Riverside Park. The interceptor alignment would cause disruption of park uses during the period of construction. Park use patterns would not be permanently altered as a result of construction-related dislocations.

No homes, businesses, or land designated for residential use will be affected over the long term by any of the Cross-Town Sewer alternates. Short term construction impacts will affect residential streets causing inconvenience but no relocation of residents.

Urban Systems

- Existing Utilities

  Construction of the Cross-Town Interceptor will be complicated by in-place facilities such as: sanitary sewer, storm drain, water, natural gas and telephone. Sewer construction presents the potential of service interruption should any of these underground lines be damaged.

  The impact of Cross-Town Sewer construction on storm drainage facilities will be slight. Care should be exercised, however, to assure that pipe drainage systems and drainage channels are protected during

the construction work such that their functions will not be impaired should they be required to transport drainage flows during the construction period.

- Streets and Traffic

Traffic impacts associated with the Cross-Town Sewer project will be short term, lasting only during the construction period. They are avoidable if no action is taken.

The major impact that will be common to all alternative routes for sewer construction is the excavation area within each area. Accounting for not only the trench itself, but room for backfilling, storage of materials and a safety clearance, it is assumed that at least a 20 foot wide construction area will be required within each street. The magnitude of this impact will vary with each street as to its width, traffic volume characteristics and amount of pedestrian activity.

Alternate CD has minimal direct impact on traffic as it leaves the intersection of Arlington and Island and runs along the south side of Wingfield Park, under the river to Jones and Riverside.

At the intersection of Riverside and Jones, Alternates AB and CD terminate at a common point, with the continuation of the project by either Sub-alternate J or R. J continues to the west on Jones Street, a wide two-lane residential street with parking, to a connection point at the western end of Jones. From strictly a traffic standpoint, impact appears to be minimal along this route, except that the four-lane Keystone Avenue approach to the River Bridge would be disrupted.

Alternate R has an advantage over J as Keystone Avenue would not be disrupted during construction. Keystone Avenue is physically separated by a grade separation structure from Riverside Drive. On the other hand, the Reno Scenic Drive route would be disturbed.

Mill Street, between Kirman Avenue and Virginia Street, is a segment common to both Alternatives AB and CD and carries between 5,000 and 10,000 vehicles per day. Depending upon the precise alignment of the sewer

within the street cross-section, various temporary lane configurations will be necessary with resulting peak-hour congestion. Traffic signals on Mill Street at the intersections of Wells, Lake, Center and Virginia may also be interrupted by construction activity. Bus routes on Mill Street will also be affected and temporary rerouting is likely.

At Mill Street and Virginia Street, Alternatives AB and CD turn to the north for one block to Island Avenue, then back to the west on Island to Arlington Avenue. The impact of delay and congestion due to construction will be great on Virginia, even though this is only a one-block segment. Virginia Street carries approximately 18,000 vehicles per day. Island Avenue, a two-lane street, will be subject to restricted travel during construction to Arlington Avenue as will First Street and Riverside Drive beyond Arlington under Alternate AB. Detours on adjacent streets can relieve some of the short-term traffic congestion.

With all alternatives, consideration of emergency vehicle access to adjacent developments; either one lane on each side of street needs to be maintained, or planking or backfilling might be considered at critical access points. Other public services that need to be maintained, yet rely on access, are refuse collection and mail delivery service.

- Existing Regional Sewerage Facilities

The Cross-Town Interceptor system will relieve the existing system of capacity sewage flows. It will accommodate flows from the existing Northwest, Dickerson Road, and Peavine Mountain Interceptors, and in addition is a vital element in the Sanitary Sewer Master Plan. There are no construction related short term impacts affecting the existing sewer system.

The no action alternative would not relieve the existing sewage system of critical overloadings. A consequence of no action could then be the occurrence of sewage overflows.

Economics

Alternate AB with Sub-alternate R is estimated to cost $1.66 million at 1975 prices (including 25 percent contingency and 15 percent for design, engineering, staking and inspection). The total annual cost, including debt servicing and present

worth of operation and maintenance is estimated to be $161,000 (S-1). This alternative has the least impact from a capital cost and yearly cost viewpoint.

Alternate AB with Sub-alternate J is estimated to cost $1.74 million. The total annual cost, including debt servicing and present worth of operation and maintenance is $168,000 (S-1). This alternate is 5 percent higher in capital costs and 4 percent higher in annual costs than Alternate AB-R.

Alternate CD with Sub-alternate J is estimated to cost $1.78 million. Total annual costs, including debt servicing and present worth operation and maintenance are estimated to be $172,000 (S-1). This alternate is similar to the cost of AB-J in that it is 7 percent higher than AB-R, the least expensive alternate.

Alternate CD with Sub-alternate R is estimated to have capital costs of 1.97 million. The total annual costs, including debt servicing and present worth operation and maintenance, is $190,000 (S-1). This alternate is approximately 19 percent more costly, on both a capital and yearly basis, than Alternate AB-R and about 12 percent greater than the other alternates.

Construction employment for the four alternatives is estimated between 30 and 35 man years, varying with construction costs.

Funding for the Cross-Town Sewer is expected to be derived from federal sources, according to the provisions of PL 92-500, amounting to 75 percent of the total capital costs. Local sources will provide the remainder. The local share of construction costs is expected to be funded through the issuance of general obligation bonds of 20 year maturity. Such debt servicing and annual O & M costs are funded from ad valorem taxes, sewer service charges and sewer connection fees. Ad valorem taxes are limited by state constitution to 5 percent of assessed valuation (35 percent of cash value). The Reno tax rate is currently at the legal limit. However, revenues from this source will increase as the taxable assessed value is augmented by new residential, commercial and industrial development and from inflation, and will provide some of the funds necessary. The remainder of the funds will come from sewer service charges and sewer connection fees, either or both of which may have to be increased to provide the total yearly funding necessary for the project. Since Alternate AB-R is least expensive from an annual cost basis, the impact

If no action is undertaken on Cross-Town Sewer construction, no economic commitments will be required. No action will preclude the employment of construction labor for the project route alternates.

COMPARISON OF IMPACTS: CROSS-TOWN SEWER ALTERNATIVES

Evaluation of the various impacts of alternative Cross-Town Sewer plans has been presented in the preceding pages. The assessment of these impacts is summarized in Table 6-U for reader convenience. Sub-alternates (R) and (J) are contrasted under both (AB) and (CD) Alternates because one sub-alternate must be selected with either major alternate.

The relative importance column associated with individual impact sources is intended as a guide in determining the desirable alternate. Items of major importance are considered sources of considerable adverse impact. Items of equal importance are unavoidable impacts of either alternate. Minor importance items should not require revision of alignment nor lead to significant adverse impacts. A plot of the relative importance of the impact sources on the environment is shown in Figure 6-13 and leads to the inescapable conclusion that $(AB)_R$ is the preferred alternate.

IMPACTS OF NO CROSS-TOWN SEWER PROJECT

Impacts of the no project alternative for the Cross-Town Sewer are summarized in Table 6-V and Figure 6-14. Selection of the no project alternate would avoid the short term direct impacts associated with construction including adverse effects on air quality, urban systems such as transportation, municipal services, water and energy utilities and facilities, acoustics, topography and scenic environment.

TABLE 6-Ua

DIRECT IMPACTS OF
CROSS-TOWN SEWER ALTERNATIVES - SUMMARY COMPARISON

Area of Impact		Impact Source	Relative Importance
Topographic	$(AB)_J$	1. 9160 lf 42" pipe through existing streets	
		2. 1 River Syphon Crossing	Equal
		3. $28,000 Landscape Restoration	
	$(AB)_R$	1. 8640 lf 42" pipe through existing streets	
		2. 1 River Syphon Crossing	Equal
		3. $28,000 Landscape Restoration	
	$(CD)_J$	1. 8750 lf 42" pipe through existing streets	
		2. 1 River Syphon Crossing	Equal
	$(CD)_R$	1. 2860 lf 42" pipe through existing streets	Equal
		2. 1 River Crossing	
Scenic and Aesthetic	$(AB)_J$	1. Through existing residential and commercial area	Equal
	$(AB)_R$	1. Through existing residential and commercial area	Equal
		2. Down Reno Scenic Drive	Minor
	$(CD)_J$	1. Through existing residential and commercial area	Equal
	$(CD)_R$	1. Through existing residential and commercial area	Equal
		2. Down Reno Scenic Drive	Minor
Recreation	$(AB)_J$	1. Route Crosses Central Gaming Area	Equal
		2. Route Crosses Wingfield Park	Equal
	$(AB)_R$	1. Route Crosses Central Gaming Area	Equal
		2. Route Crosses Wingfield Park	Equal
		3. Route will interrupt park adjacent to Reno Scenic Drive	Minor

TABLE 6-Ub

DIRECT IMPACTS OF
CROSS-TOWN SEWER ALTERNATIVES - SUMMARY COMPARISON
(continued)

Area of Impact		Impact Source	Relative Importance
Recreation	$(CD)_J$	1. Route Crosses Central Gaming Area	Equal
		2. Route Crosses Riverside Park	Equal
		3. Route will interrupt boating @ river crossing	Minor
	$(CD)_R$	1. Route crosses Central Gaming Area	Equal
		2. Route crosses Riverside Park	Equal
		3. Route will interrupt park use adjacent to Reno Scenic Drive	Minor
Archaeologic	$(AB)_J$	1. Surface and subsurface artifacts	Equal
	$(AB)_R$	1. Surface and subsurface artifacts	Equal
	$(CD)_J$	1. Surface and subsurface artifacts	Equal
	$(CD)_R$	1. Surface and subsurface artifacts	Equal
Soils Geologic Seismic	$(AB)_J$	1. Contamination risk to soils if breakage occurs	Equal
	$(AB)_R$	1. Contamination risk to soils if breakage occurs	Equal
	$(CD)_J$	1. Contamination risk to soils if breakage occurs	Equal
	$(CD)_R$	1. Contamination risk to soils if breakage occurs	Equal
Hydrology & Water Quality	$(AB)_J$	1. Contamination risk to river if breakage occurs	Equal
		2. Disturbance of settled river soils at Arlington Ave. river crossing	Minor
	$(AB)_R$	1. Contamination risk to river if breakage occurs	Equal
		2. Disturbance of settled river soils at Arlington Ave. river crossing	Minor
	$(CD)_J$	1. Same as AB_J	Equal
		2. Same as AB_J	Minor
	$(CD)_R$	1. Same as AB_R	Equal
		2. Same as AB_R	Minor

TABLE 6-Uc

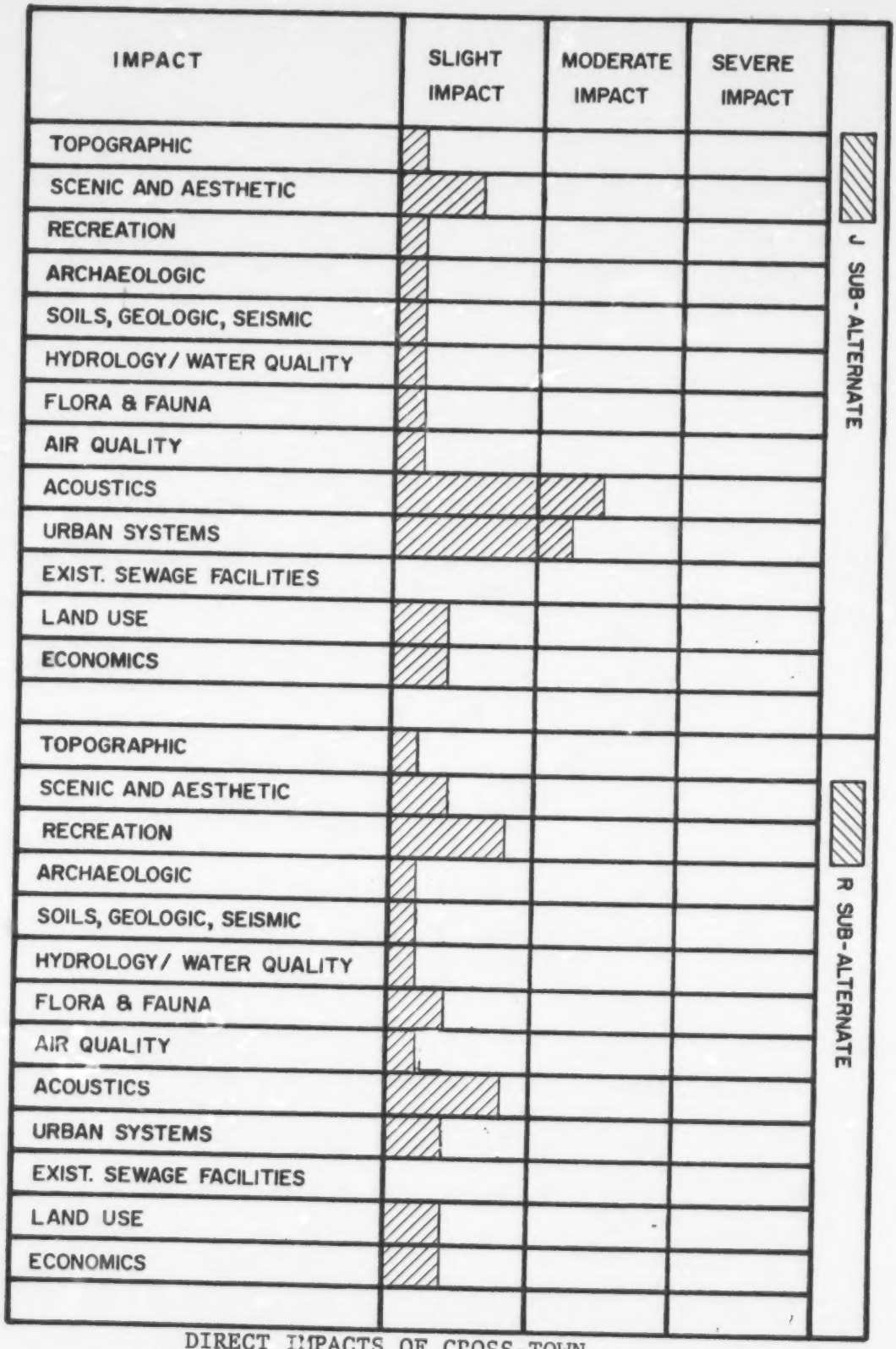
DIRECT IMPACTS OF
CROSS-TOWN SEWER ALTERNATIVES - SUMMARY COMPARISON
(continued)

Area of Impact		Impact Source	Relative Importance
Flora and Fauna	$(AB)_J$	1. Disturbance in Wingfield Park	Equal
		2. Disturbance at River crossing	Minor
	$(AB)_R$	1. Disturbance in Wingfield Park	Equal
		2. Disturbance adjacent of Reno Scenic Drive	Minor
		3. Disturbance at River crossing	Minor
	$(CD)_J$	1. Disturbance in Riverside Park	Equal
		2. Disturbance at River crossing	Major
	$(CD)_R$	1. Disturbance in Wingfield Park	Equal
		2. Disturbance adjacent to Reno Scenic Drive	Minor
		3. Disturbance at River crossing	Major
Air Quality	$(AB)_J$	1. Construction dust and vehicle fumes	Equal
	$(AB)_R$	1. Construction dust and vehicle fumes	Equal
	$(CD)_J$	1. Construction dust and vehicle fumes	Equal
	$(CD)_R$	1. Construction dust and vehicle fumes	Equal
Acoustics	$(AB)_J$	1. Noise through residential, commercial and recreation area	Equal
	$(AB)_R$	1. Noise through residential, commercial and recreation area (fewer receptors on Riverside Drive)	Minor
	$(CD)_J$	1. Noise through residential, commercial and recreation area	Equal
	$(CD)_R$	1. Noise through residential, commercial and recreation area (fewer receptors)	Minor
Urban Systems	$(AB)_J$	1. Material and Energy Use	Equal
		2. Traffic interruption at Keystone Bridge at Jones Street	Major
		3. Jones Street ADT loads	Major
	$(AB)_R$	1. Material and Energy Use (water control)	Minor

TABLE 6-Ud

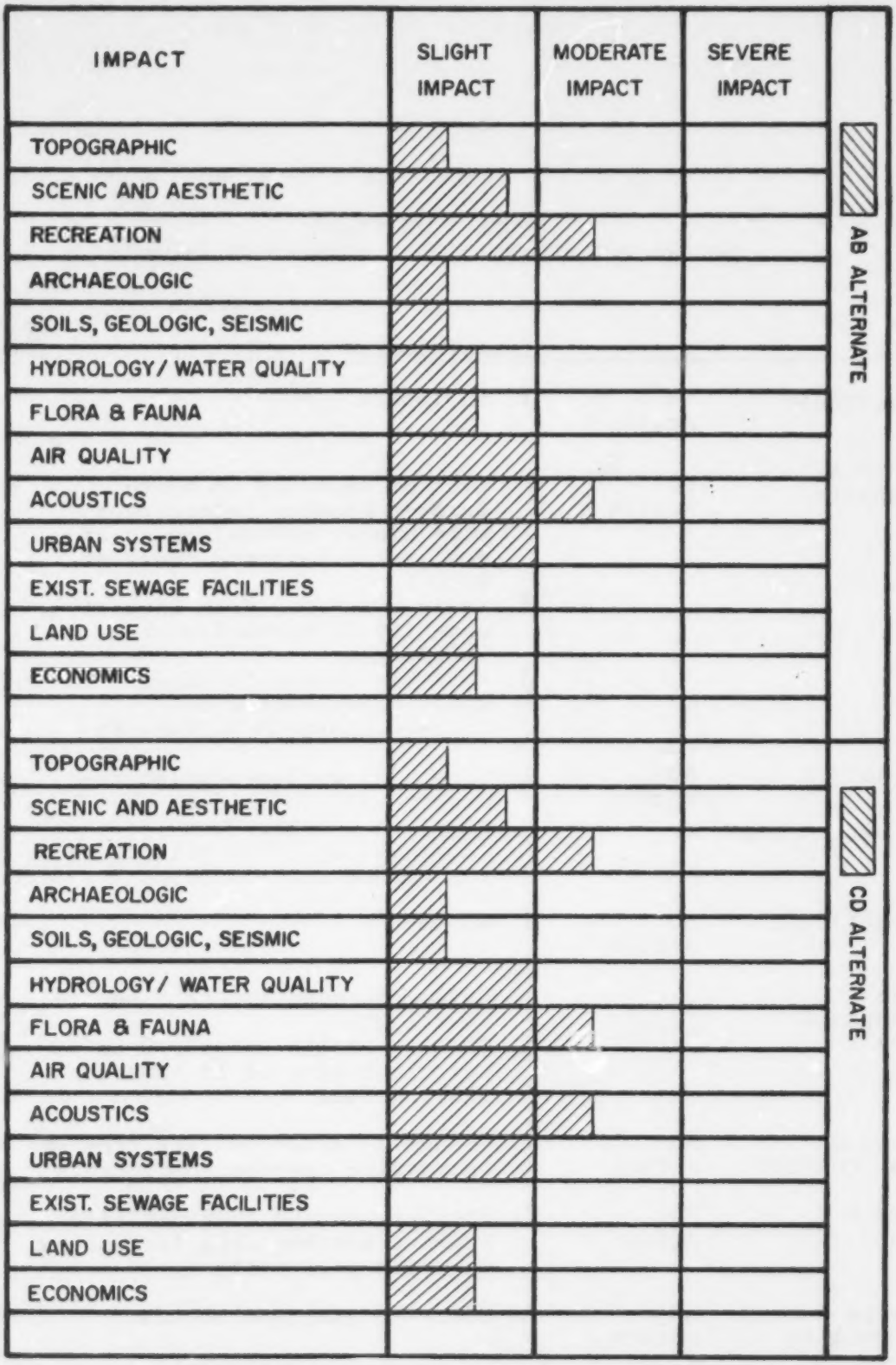
DIRECT IMPACTS OF
CROSS-TOWN SEWER ALTERNATIVES - SUMMARY COMPARISON
(continued)

Area of Impact		Impact Source	Relative Importance
	$(CD)_J$	1. Material and Energy Use	Equal
		2. Traffic interruption at Keystone Bridge at Jones Street	Major
	$(CD)_R$	1. Material and Energy Use (water control)	Minor
Existing Sewage Facilities	$(AB)_J$	Possible interference with existing sewers at Jones St. & Riverside Dr.	Minor
	$(AB)_R$	No Impact	
	$(CD)_J$	Possible interference with existing sewers at Jones St. and Riverside Dr.	Minor
	$(CD)_R$	No Impact	
Land Use	$(AB)_J$	1. Use of Wingfield Park	Equal
	$(AB)R$	1. Use of Wingfield Park	Equal
		2. Use of park adjacent to Riverside Drive	Minor
	$(CD)_J$	Use of Riverside Park	Equal
	$(CD)_R$	1. Use of Riverside Park	Equal
		2. Use of park adjacent to Riverside Drive	Minor
Economics	$(AB)_J$	1. Sewer cost ($1,736,000)	Equal
	$(AB)_R$	1. Sewer cost ($1,657,000)	Equal
	$(CD)_J$	1. Sewer cost ($1,776,000)	Equal
	$(CD)_R$	1. Sewer cost ($1,968,000)	Equal



DIRECT IMPACTS OF CROSS-TOWN
ALTERNATIVES AND SUB-ALTERNATIVES -
SUMMARY AND COMPARISON

Figure 6-13-A



DIRECT IMPACTS OF CROSS-TOWN ALTERNATIVES
AND SUB-ALTERNATIVES - SUMMARY AND COMPARISON

Figure 6-13-B

TABLE 6-Va

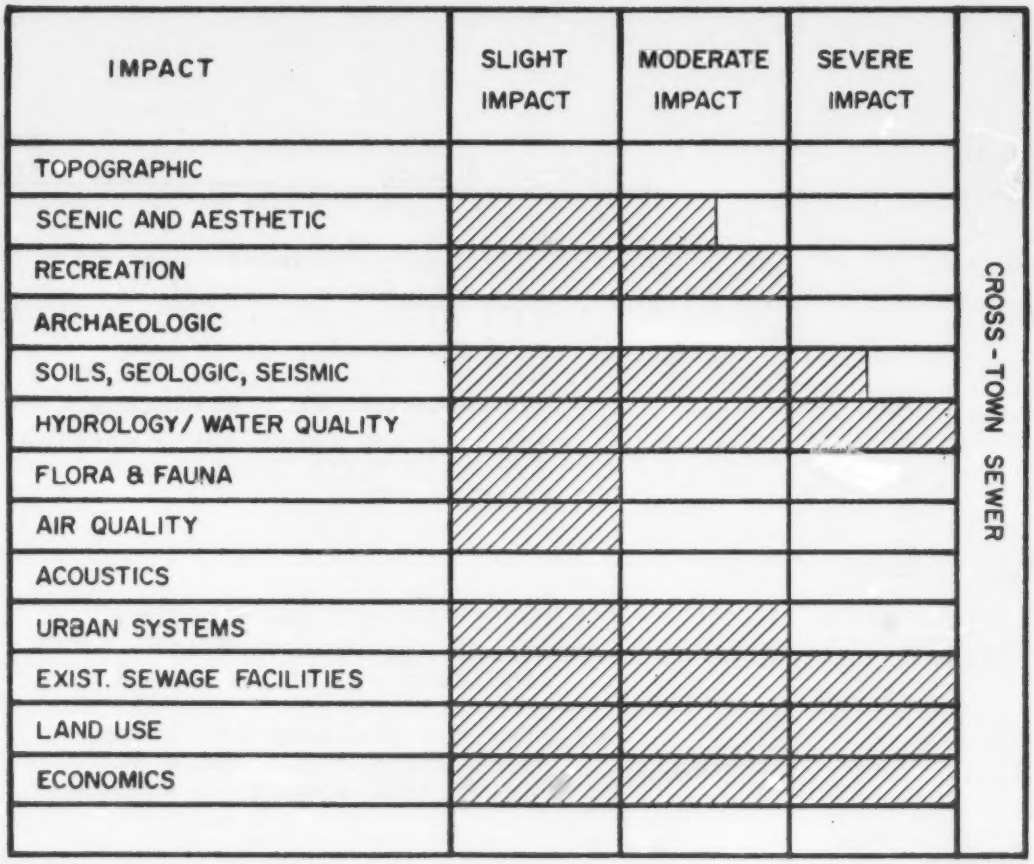
CROSS-TOWN SEWER
NO PROJECT ALTERNATIVE - SUMMARY OF IMPACTS

Area of Impact		Impact Source	Relative Importance
Topographic	No Action	1. No impact	
Scenic & Aesthetic	No Action	1. Lack of capacity in North Truckee Meadows Interceptor will hinder redevelopment of designated blighted areas of Zone I	Major
		2. Sewer overflows from lack of capacity in North Truckee Interceptor	Major
		3. Possible change in river water clarity from increased upstream pollutants	Minor
Recreation	No Action	1. Growth in gaming-tourist industry will shift from downtown and western Reno	Major
		2. Increased upstream pollutants may hinder river uses.	Minor
Archaeologic	No Action	1. No impact	-
Soils Geologic & Seismic	No Action	1. Soil contamination from sewage overflows	Major
		2. Greater health hazards from seismic rupturing of sewers flowing full	Major
Hydrology Water Quality	No Action	1. Change in water quality from increasing upstream pollutants	Major
Flora & Fauna	No Action	1. Possible damage to river life support systems from increasing upstream pollutants	Minor
Climate & Air Quality	No Action	1. Odors if overflow occurs.	Major
Acoustics	No Action	1. No impact	

TABLE 6-Vb

CROSS-TOWN SEWER
NO PROJECT ALTERNATIVE - SUMMARY OF IMPACTS
(continued)

Area of Impact		Impact Source	Relative Importance
Land Use	No Action	1. Will hinder redevelopment of downtown Reno	Major
		2. Will hinder development west of Reno	Major
		3. Will force development to southeastern Reno (existing Mill Street Interceptor service area and South Truckee Meadows service area)	Major
Urban Systems			
Existing Utilities	No Action	1. Will not relieve problems occurring from combined sanitary and storm sewers	Minor
Streets & Traffic	No Action	1. Traffic problems resulting from surface discharge at overloaded sewers	Minor
Existing Regional Sewerage Facilities	No Action	1. No relief of existing sewer system overload problems	Major
		2. Would necessitate revisions of sewer master plan	Major
Economics	No Action	1. Loss in revenues from construction	Minor
		2. Loss in revenues from curtailed development rate	Major
		3. Possible leveling off of tourism.	Major



IMPACTS OF NO PROJECT FOR THE CROSS-TOWN SEWER - SUMMARY

Figure 6-14

The Cross-Town Sewer currently carries sewage flows from downtown Reno and from Service Zones 1, 3 and 7 (Figure 3-16) to the North Truckee Meadows Interceptor. The total flows arriving at this interceptor constitute an existing overload which sewer master planning studies (S-1) indicate would be relieved by extension of the Mill Street Interceptor (Cross-Town Sewer) to carry flows from areas 1, 3 and 7. The Cross-Town Sewer thus forms an important link in the overall sewer master plan for much of the northwest, western Reno area and, by reason of diverting flows, also accommodates further development of the downtown area. The no project alternative would result in growth moratoria in these areas unless alternate means of sewage diversion to the Mill Street Interceptor are devised. If urbanization was suspended in this area, development would probably be shifted to the east and southern parts of the city currently served by sewers, assuming the treatment plant was expanded.

In addition to the Cross-Town Sewer's function as a diversion of existing sewage flow from the North Truckee Meadows Interceptor, it will serve as the means by which sewage from the Lawton-Verdi corridor would be carried to the regional treatment plant at Vista. Therefore, selection of the no project alternative would require the design of a new link between the Lawton-Verdi Interceptor and the JWPCP or abandonment of plans for the Lawton-Verdi Interceptor and thus will have long term, secondary adverse impacts on water quality and aquatic life. These impacts are discussed under the section entitled "No Project: Lawton-Verdi Sewer Extension".

The no project alternative would avoid disruption of Wingfield Park. It would also avoid the economic consequences of probable sewer service charge and connection fee increases. The adverse consequence of no action is a serious threat of pollution of the Truckee River and to intervening lands as the result of possible sewer overflows. Capacity of the North Truckee Meadows Interceptor trunk line near East Second Street and east of the river is 11.8 MGD. In 1974, peak dry weather flows were metered in this line at 11.5 MGD and, during storm periods, instantaneous flows in excess of 20.0 MGD are contributed by the combined storm and sanitary sewers in the older parts of Reno. These high flows have surcharged manholes to elevations near the ground surface and pose an imminent probability that stormwater overflows will occur (S-1).

IMPACTS OF LAWTON-VERDI SEWER RIVER ROUTE ON THE ROUTE ENVIRONS

Topography

The topographic impacts resulting from construction of the Lawton-Verdi Interceptor River Route will be confined to a 50 foot wide corridor adjacent to the Truckee River from Dickerson Road west to the Town of Verdi. Long term topographic alterations resulting from trenching, river crossings, and job site storage, will be modest. The removal of vegetation will increase erosion potential, and will necessitate permanent topographic alterations and additions such as bench slopes and berm construction. Maintenance access roads will be permanent and, in addition, call for measures to reduce erosion potential resulting from increased runoff. Alterations to the river channel at crossings will necessitate placement of rip-rap or similar erosion prevention measures. Short term construction impacts will be similar to those described for Alternate AB of the Cross-Town Sewer.

Scenic and Aesthetic Characteristics

Short term construction impacts will be from the operation of construction equipment and maintenance yards which may create dust and smoke and contribute to a temporary change of the rural-recreational character of the river. Interceptor construction will leave behind several long term visual reminders. In addition to the aforementioned access road and erosion prevention measures, long term visual impacts will result from manhole chimneys which must be above the maximum river level and therefore visable and pipe which may be exposed at ditch crossings. The river route proposes twelve major and three service river crossings posing the greater potential for temporary alteration to the river and permanent visual impacts of visable pipe at river crossings.

Men and equipment will be active in opening trenches, laying pipe, backfilling and compacting in the relatively narrow but long construction area. This action will be in contrast to man's normal inactivity along the river itself.

Recreation

Temporary damming on the routes of the river would interfere with the active (fishing) and passive recreational potential of the upper Truckee River in the construction areas. Since this alternative route has many crossings, there would be

many more potential impacts on recreation from this alternative. Open space between existing development offers various forms of recreational potential including hiking, trail bikes, etc. Construction of the interceptor would create short term interference with these activities. There would be no long term impact on recreation.

Archaeologic Resources

Potential historic and pre-historic sites in the path of the proposed Lawton-Verdi Interceptor alignment have been given the designations Site 26 Wa 2156, Site 26 Wa 1407, and Site 26 Wa 68.

Site 26 Wa 2156, near the Truckee River produced several boulder metates but no waste flakes or stone tools. The river alignment of the Lawton-Verdi Interceptor crosses this potentially significant area, and may distrub scattered surface and sub-surface artifacts. When the final alignment is determined, a detailed field survey should be conducted to assess the exact impact on archaeologic resources and make appropriate recommendations for mitigation measures.

Site 26 Wa 1407, along the Truckee River in Verdi, has been described as a bed-rock morter and metate site. Waste flakes were found scattered across the site. These findings indicate past usage of the site; however, further reconnaissance is necessary to ascertain the site's significance. Construction prior to further site investigation may dislodge artifacts and possibly distort the true value of such findings.

Site 26 Wa 68, regarded by local residents as an historic Washoe camp area, has in the past yielded pre-historic rock carvings and other remnants of early native American usage. Remnants of past use along with petroglyphs have been displaced from their original context by past construction.

Interceptor construction through this site may unearth other potentially significant resources. More extensive field research is recommended at this location, prior to construction to ascertain the importance of the site.

Soils, Geology and Seismicity

Excavations for the Lawton-Verdi Interceptor will create vertical trenches in granular soils which will be subject to erosion and caving. Trench excavations will require shoring of trench walls or sloping at 1:1. Shoring is also

anticipated in the areas where the proposed pipeline excavation would encroach on existing irrigation ditches and other slopes. Caving of the trench wall is likely to be more serious in areas of high groundwater and dewatering will be required. There is the possibility of damage to adjacent structures including scour by river action. Dewatering and shoring may be necessary or installation of the line by either horizontal drilling and/or jacking may be required. In general, the material from the trench will be suitable for backfill; however, large size material should be excluded. The oversize material should be removed and disposed of in suitable areas. If select material is required, it may be necessary to utilize abandoned quarries between Reno and Verdi; however, screening facilities will be needed. Erosion of slopes adjacent to the Truckee River will require rip-rap slope protection. Berms or V-ditches can be installed at the top of slopes to prevent excessive runoff erosion. Erosion of trench backfill in sloping areas can be reduced by placement of surfacing or rip-rap. Spoil piles will be subject to erosion and protective covering may be necessary. Long term impacts of interceptor extension to Verdi may include the following:

1) Contamination of soil due to accidental rupture or break in the sewer line.

2) Decrease in contamination of soil from reduction in septic tank use.

3) Exposure of sewer line under the Truckee River due to scour.

4) Indirect impact on mineral resources, that is, increased sewer facilities will accommodate urban development which could encroach on areas of potential mineral resources and prevent future exploitation.

All construction alternates and sub-alternates will be subjected to the same seismic risks. The actual performance of individual sections of pipe in an earthquake may depend on several dynamic factors such as earthquake magnitude and displacements. Possible damage to sewer line from the effects or earthquake ground shaking could be caused by:

1) Surface cracks from earth lurching in weak soils, particularly in locations close to river banks.

2) Possible surface settlement from liquefaction and/or differential compaction or densification. These conditions could be identified by site investigations including test borings.

Geology underlying the pipelines consists of stream and valley alluvium with occasional large boulders. Groundwater is relatively high and will present the need for dewatering on portions of the routes.

There are no direct soils, geologic or seismic impacts of no action. However, the currently overloaded trunk sewers would remain as a significant source of groundwater and surface pollution in the event of failure under seismic stress.

Hydrology/Water Quality

Construction of the Lawton-Verdi Interceptor Sewer will not have a primary long term impact on the surface water or groundwater resources of the study area. Significant short term adverse impacts on Truckee River water quality will be experienced during construction of the interceptor along the river route. Impacts will arise from increased turbidity and suspended solids levels, resulting primarily from the twelve major river crossings and the additional crossings for laterals. In addition, the construction of the sewer immediately adjacent to the river may serve to increase turbidity and solids during the construction phase. These impacts will be short term and significant in the local downstream areas.

Secondary long term beneficial impacts on water quality will result from the construction of this interceptor due to the controlled regional treatment program that eliminates separate smaller waste treatment facilities and reduces septic tank use.

Flora and Fauna

Damage to the aquatic ecosystem resulting from the numerous river crossings is considered a very significant impact. Increased sediment loads in the river would result in downstream turbidity and siltation which would blanket benthic communities in the stream. The construction site itself would be temporarily removed from aquatic productivity and the immobile populations of invertebrates destroyed at each site. If construction occurs during spawning runs of the Lahontan cutthroat trout or during the early life history of the fry,

the increased turbidity and sedimentation could adversely affect this threatened species. The critical period for the cutthroat is March through May. Construction will have a short term impact on the aquatic biota of the Truckee River. If crossings are constructed consecutively and each takes a period of 1 month, which is not unsually long for pipeline crossings, the cumulative impact to aquatic communities of the Truckee River could be extensive.

A short term adverse impact on terrestrial vegetation and wildlife will result from implementation of the river route alignment. Riparian vegetation communities along many portions of the Truckee River will be destroyed. Revegetation rates along the lower Truckee River have been reported to be slow and will probably require several years to reestablish a "perennial vegetative canopy".

Air Quality

Construction of the Lawton-Verdi Sewer will cause local increases in suspended particulates along the pipeline routes due to earthmoving and vehicular traffic. The construction equipment will emit pollutants associated with internal combustion engines. These impacts are considered minor and will have only short term effects.

Acoustics

Noise introduced by earthmoving equipment, materials handling equipment, impact equipment and stationary equipment such as pumps and generators will range from 68 dBA to 105 dBA, 50 feet from the noise source. These construction noise levels will have adverse impacts on area wildlife and scattered local residents. There will be no long term impacts on acoustics.

Urban Systems

Many of the general traffic impacts associated with the Cross-Town Sewer are applicable to the Lawton-Verdi Sewer, primarily access to adjacent developments and maintenance of traffic when crossing streets or within streets.

Both Alternate 1 (river route) and Alternate 2 (railroad route) cross a minimum of local streets. However, Alternate 2 necessitates a crossing of U. S. 40 near the western terminus of the sewer. Traffic control will be particularly critical at this location due to the volume and high speed travel on U. S. 40.

Interruption of underground utility service as may be necessitated by construction is a short term adverse impact. Existing sewage facilities may be phased out as interceptor connections are made available. The local facilities directly affected by the Lawton-Verdi Interceptor are 1) River Inn and 2) Glen Meadows.

The impact the actual construction of the Lawton and Cross-Town Sewer projects would have on storm drainage facilities will be slight. Care should be exercised, however, to assure that pipe drainage systems and drainage channels are protected during the construction work such that their functions will not be impaired should they be required to transport drainage flows during the construction period.

Existing Regional Sewerage Facilities

As stated in other sections, there is no unified collection system or treatment method in operation. Septic tanks and local treatment facilities at Glen Meadows and River Inn are the only current means of wastewater treatment in the Lawton-Verdi corridor. The long term beneficial effects of the proposed Lawton-Verdi Interceptor will be the implementation of uniform sewage treatment and collection.

Land Use

Construction of the Lawton-Verdi Interceptor will generate significant land-use impacts previously discussed as a regional issue. However, the specific sewer alignment has little consequences as a determinant of land usage within the corridor. In general, the river and railroad alignments are, from Reno to Verdi, within 500 to 1000 feet of each other. There is, at present, virtually no significant development along either route. Existing land uses are primarily agricultural and the river route alternative will displace no housing or business.

Economics

The river route, Alternative 1, is estimated to involve capital costs of $9.5 million at 1975 prices (including 25 percent for contingencies and 15 percent for design, engineering, stating and inspection). The total annual cost, including debt servicing and present worth of operation and maintenance is estimated to be $926,000 on a 20 year amortization basis and $742,000 on 40 year amortization (S-1). This alternate is more expensive to build than the railroad route, primarily because it requires 11,600 linear feet more pipe (caused by river meander); involves

twelve primary river crossings, all requiring water tight pipes and manholes; requires construction of heavy equipment access roads; and involves extensive revegetation and relandscaping in vicinity of river crossings and access roads. Construction environment is estimated at 171 man years.

As with the Cross-Town Sewer, funding for the Lawton-Verdi Interceptor is expected to be derived from federal sources, according to the provisions of PL 92-500, amounting to 75 percent of the total capital costs. Local sources will provide the remainder in the manner previously discussed in relation to the Cross-Town Sewer.

The river route involves somewhat lower yearly costs than the railroad route, primarily because there are no lift stations to service some low lying tributary areas requiring fuel and maintenance. This alternative will involve impact on sewer service charges and connection fees amounting to about one half of one percent less than the railroad alternate, a very slight difference.

IMPACTS OF LAWTON-VERDI SEWER RAILROAD ROUTE ON THE ROUTE ENVIRONS

Topography

There are no significant topographic impacts associated with the railroad alternate. Cleared and graded space paralleling the railroad will be used for construction and maintenance purposes, reducing grading needs. Otherwise the short term construction impacts will be similar to those described in Alternate AB of the Cross-Town Sewer.

Scenic and Aesthetic Characteristics

Short term construction operations will introduce short term scenic impacts such as dust and smoke. Topographic restraints on interceptor construction dictate placement of pipe hangers, trestles, ditch crossings, and sewage lift stations. These items will permanently become a part of the rural landscape. Slope protection measures such as benches, rip-rap, and berms will be implemented which will also alter the visual character of the landscape but will not differ markedly from the man-made character of the railroad right of way.

Recreation

This route has the fewest river crossings of the alternate routes proposed, with only one for the main trunk and four for tributary collector sewers. Otherwise its short term and long term impacts are identical to those described on the river routes but of less cumulative impact.

Archaeology

There are no known archaeologic sites which will be affected by the proposed alignment of the Railroad Alternates, although it is considered possible that subsurface archaeology may be uncovered.

Soils, Geology, Seismicity

Soils, geologic, and seismic impacts for the railroad route are similar to those presented in discussion of the river route, except that less dewatering of construction trenches will be necessary.

Hydrology/Water Quality

Construction along the railroad route for the Lawton-Verdi Sewer will have no foreseeable direct long term impacts on surface or groundwater resources. Adverse short term water quality impacts associated with construction of this alternative should be significantly less than for the river route since only one major river crossing is required along with four service crossings. Short term significant increases in turbidity and suspended solids will be observed in the vicinity of river crossings.

Flora and Fauna

Impacts on aquatic biota resulting from increased turbidity and sedimentation due to the river crossings for the railroad route are considered short term and less significant than those resulting from construction along the river route which requires more disturbance of the river bottom. Vegetation and wildlife habitat along the construction route will be disrupted or destroyed, but, again, to a much lesser degree than for the river route.

Air Quality

Impacts on air quality resulting from construction of the Lawton-Verdi Sewer along the railroad route will be identical to those resulting from construction along the river route.

Acoustics

Construction noise could have adverse impacts on area wildlife and local residents. Noise introduced by earthmoving equipment, materials handling equipment, impact equipment, and stationary equipment such as pumps and generators will range between 85 and 105 dBA, at 50 feet from the noise source.

Urban Systems

Traffic impacts of Alternate 2 are similar to the river route. Facilities used and energy consumed during construction will be comparable with that consumed for the river route. The higher elevations of the interceptor alignment, however, will necessitate the installation and maintenance of pump stations at locations shown on Figure 5-4.

The impact the actual construction of the sewer projects would have on storm drainage facilities will be slight. Care should be exercised, however, to assure that pipe drainage systems and drainage channels are protected during the construction work such that their functions will not be impaired should they be required to transport drainage flows during the construction period.

Existing Regional Sewerage Facilities

As pointed out in the previous river route sections, there is no unified sewage treatment or collection system in operation. Construction of either railroad or river alternatives will allow phasing out of septic tanks and local systems at River Inn and Glen Meadows.

Land Use

The land use impacts, as pointed out previously, are not sensitive to the alignment alternatives.

Railroad route alternatives of the Lawton-Verdi Sewer will utilize existing railroad easements where possible and thus present no potential for displacement of business or housing. In a similar manner little or no future land designated for housing purposes will be affected.

Economics

The railroad route, Alternate 2, is estimated to cost $8.9 million. Total annual costs, including debt servicing and present worth of operation and maintenance, is estimated to be $921,750 on the basis of 20 year amortization and $964,000 for 40 year amortization (S-1). The railroad route will involve some difficult construction techniques, including railroad jacking, tunneling, 3,900 feet of tressels, pipe hangers, extensive trench shoring and dewatering, and construction of lift stations. Construction employment is estimated at 160 man years.

Funding sources for this alternative are identical to those for the river route. Local revenue sources are also the same. The railroad alignment, because it requires lift stations, has a higher annual cost, amounting to about 2 percent greater per year than the river alternate. This will correspondingly have a very slightly greater effect on sewer service charges and fees (25 percent of 2 percent or about one half of 1 percent).

COMPARISON OF IMPACTS FOR THE LAWTON-VERDI SEWER ALTERNATES

Contrasting the railroad and river alignments at a macro level reveals little differences between the two. Impacts on recreation, soils and geology, air quality, acoustics, existing sewerage facilities, land use, demographics and economics are of equal magnitude for both Lawton-Verdi Alternates. On the micro level, however, significant environmental differences presen ed by the SEA facilities plan and illuminated in Chapter 5 become important. These differences in impacts are presented in prior sections of this chapter and summarized in Table 6-W for reader convenience.

The relative importance column associated with individual impact sources is intended as a guide in determining the desirable alternate. Items of major importance are considered sources of considerable adverse impact. Items of equal importance are unavoidable impacts of either alternate. Minor importance items should not require revision of alignment nor lead to significant adverse impacts. A plot of the relative importance of the impact sources on the environment is shown in Figure 6-15 and leads to the inescapable conclusion that the railroad route is the preferred alternate.

TABLE 6-Wa

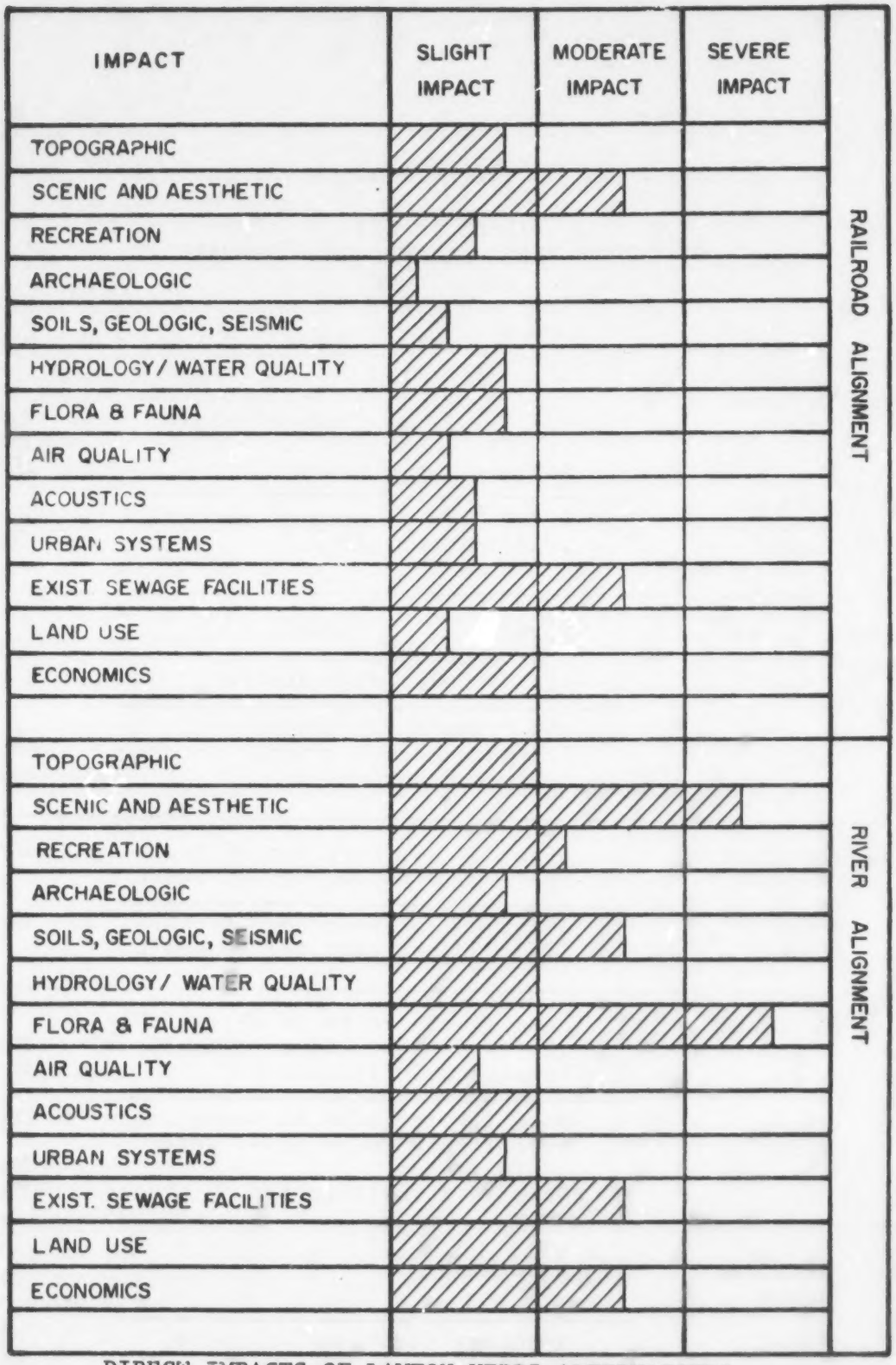
DIRECT IMPACTS
OF LAWTON-VERDI ALTERNATES - SUMMARY

Area of Impact		Impact Source	Relative Importance
Water Quality	Railroad Route	1. 4 service crossings of River	Equal
		2. Construction dust	Equal
	River Route	1. 3 service crossings of river	Equal
		2. Construction dust	Equal
		3. 12 River crossings by interceptor (3500 l.f.)	Major
		4. Likely to be covered by flooding	Major
Energy	Railroad Route	1. 7 pump stations (fuel cost @ total operation $10,000/year + 7% inflation per year)	Minor
		2. Energy required for construction	Equal
	River Route	1. Energy required for construction	Equal
Land Use	Railroad Route	1. $150,000 for easement purchase	Equal
		2. Utilization of existing cleared railroad easement where available	Minor
	River Route	1. $150,000 for easement purchase	Equal
		2. Utilization of existing open space	Major
Topographic	Railroad Route	1. 48,500 l.f. of trenching	Minor
	River Route	1. 60,100 l.f. of trenching	Major

TABLE 6-Wb

DIRECT IMPACTS
OF LAWTON-VERDI ALTERNATES - SUMMARY
(continued)

Trans-portation	Railroad Route	1. 3,700 l.f. of roadway repair	Equal
		2. Traffic control	Equal
		3. Railway interference	Minor
	River Route	1. 4,700 l.f. of roadway repair	Equal
		2. Traffic control	Equal
Scenic, Aesthetic	Railroad Route	1. 3,900 l.f. of Trestle	Major
		2. 6 Ditch Crossings	Minor
		3. 113 Manholes with Risers	Minor
	River Route	1. 154 Manholes with Risers (adjacent to River)	Major
		2. 2 Ditch Crossings	Minor
Economics	Railroad Route	1. $921,750 per year for 20 years	Equal
		2. $964,000 per year for 40 years	
	River Route	1. $926,000 per year for 20 years	Equal
		2. $742,000 per year for 40 years	
Ground-water Quality	Railroad	1. Less likely to be in water table (20 to 40 feet higher than River)	Minor
		2. Seepage & infiltration	Minor
	River Route	1. More likely to be in water table	Major
		2. More likely to be under water in floods	Major
		3. Seepage & infiltration	Major
Archae-ology	Railroad Route	1. None known	
	River Route	1. Requires additional on site investigation	Minor



DIRECT IMPACTS OF LAWTON-VERDI ALTERNATIVES
AND SUB-ALTERNATIVES - SUMMARY AND COMPARISON

Figure 6-15

IMPACTS OF NO LAWTON-VERDI SEWER PROJECT

Impacts of the no project alternative for the Lawton-Verdi Interceptor are summarized in Table 6-X and Figure 6-16. Selection of the no action alternative will eliminate the short term direct impacts associated with construction including adverse effects on air quality, water quality and the biota of the Truckee River system (temporary). Effects of the proposed project on the scenic corridor, recreation areas, archaeologic resources and acoustics would also be avoided.

However, the decision not to serve the Lawton-Verdi area with the regional sewerage system will have long term adverse impacts on water quality and aquatic life. Water quality degradation resulting from increased usage of septic tanks and small inefficient treatment facilities will adversely affect the aquatic ecosystem of the river and the domestic water supply of Reno and Sparks. Groundwater quality will probably be affected for similar reasons and ultimately require a greater degree of treatment if it is to be used for human consumption. Pyramid Lake, which eventually receives a large portion of the Truckee River flow, and whose fishery depends on the river as a spawning stream, will be adversely affected if no action is taken to provide sewer service to the population along the Verdi-Lawton corridor.

Consideration of impacts resulting from the Lawton-Verdi and Cross-Town Interceptor Sewers must be an interdependent process because each system has been designed as part of the entire sewerage and wastewater treatment program for the Reno-Sparks service area. The Lawton-Verdi Interceptor is planned to be tributary to the Cross-Town Sewer and would not function without it under the present sewer master plan. Selection of the no project alternative for Lawton-Verdi would require reevaluation of the Cross-Town Sewer and future intent to serve west and northwest Reno as well as Lawton and Verdi.

Implementation of the no project alternative would have substantial land use, urbanization and population distribution consequences. Urbanization would take place only insofar as local treatment plants and/or septic tanks were permitted. Population growth, which is forecasted by SEA (S-1) in the Lawton-Verdi area, would be redirected to Truckee Meadows, assuming the treatment plant was expanded.

TABLE 6-Xa

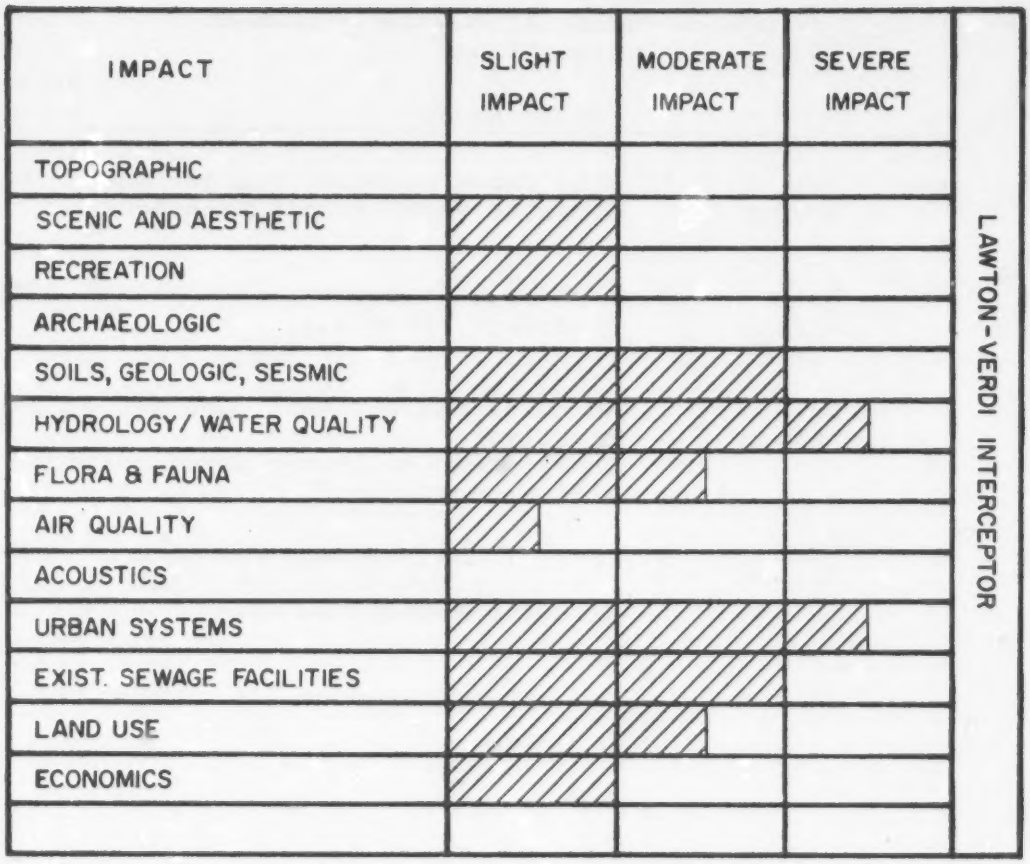
IMPACTS OF NO PROJECT FOR
THE LAWTON-VERDI INTERCEPTOR - SUMMARY

Area of Impact		Impact Source	Relative Importance
Topographic	No Action	1. No impact	
Scenic & Aesthetic	No Action	1. Existing local treatment facilities will continue in operation	Minor
		2. Possible change in river water clarity from increased upstream pollutants	Minor
Recreation	No Action	1. Use of the river may be hindered by upstream pollutants	Minor
Archaeologic	No Action	1. No impact	
Soils Geologic & Seismic	No Action	1. Soil and groundwater contamination risks from existing sub-surface sewage disposal techniques	Major
Hydrology Water Quality	No Action	1. Surface water contamination	Major
		2. Groundwater contamination	Major
		3. Will eventually cause employment of higher treatment techniques for domestic water supply	Major
Flora & Fauna	No Action	1. May damage aquatic life support systems as pollutant concentrations increase	Major
Air Quality	No Action	1. Odors from existing local treatment systems will prevail	Minor
Acoustics	No Action	1. No impact	

TABLE 6-Xb

IMPACTS OF NO PROJECT FOR
THE LAWTON-VERDI INTERCEPTOR - SUMMARY
(continued)

Area of Impact		Impact Source	Relative Importance
Urban Systems	No Action	1. Will cause eventual upgrade in domestic water supply treatment	Major
Existing Regional Sewerage Facilities	No Action	1. May necessitate upgrade in local treatment techniques	Major
Land Use	No Action	1. No development within 2000 ft. of the river.	Minor
		2. Development in Lawton-Verdi corridor will be restrained	Major
Economics	No Action	1. Loss of construction revenues	Minor
		2. Cost of higher treatment techniques for Domestic Water Supply	Minor



IMPACTS OF NO PROJECT FOR THE
LAWTON-VERDI INTERCEPTOR - SUMMARY

Figure 6-16

The economic effects, involving probable increase in the sewer service charge and connection fees, would be avoided with the no project alternative.

Partial construction in the near future of the sewer line to Lawton--with the no project alternate at this time to Verdi--warrants definition. Under this alternate, beneficial impacts on water quality would be obtained since both the River Inn and Glen Meadows individual treatment systems would be intercepted, and the most logical areas for future growth, by reason of their proximity to existing urban services, would be served by the regional sewer system and not by individual septic tanks.

The related impacts on regional land use, which would tend to more closely balance growth around the urban core, appear compatible with general plan goals. Capital cost of sewer construction to Lawton's along the railroad route is estimated at $4.0 million with a total annual cost of $316,000 including debt servicing and present worth of operation and maintenance.

All other impacts for construction to Lawton only would tend to be reduced by approximately 45 percent in direct proportion to the reduced length of the construction-impacted route.

Under the partial construction to Lawton only at this time, the pipe size of this line and of the Cross-Town Sewer should be capable of accommodating the flows from the tributary area to Verdi. If this is not done, a parallel pipeline would have to be built in these two reaches in the future causing impacts that will be equal or greater than those described herein for the Cross-Town Sewer and the segment from Reno to Lawton.

MOST VIABLE PROJECT ALTERNATIVE

Cross-Town Sewer

Of all of the project and no project alternatives identified in the facilities plans and considered in this chapter as to their environmental impacts, the clearest mandate for action centers on the Cross-Town Sewer. Protection of public health, safety and welfare as well as Truckee River water quality from the serious threat of raw sewage overflows from presently over-loaded sewers would be accomplished.

Short term environmental impacts due to construction are balanced by long term protection of surface water quality. The action is clearly compatible with planning goals for the area and is an integral part of the City of Reno Master Sewerage Program. While growth accommodation is involved in the sizing of the proposed sewer, it is the case that a 20 year planning period, cost-effectiveness and current necessity are all correctly addressed in the facilities plan.

Cross-Town Sewer Alternate AB-R is the proposed project. This alternate is identified due to its minimization of construction activity in the riverway and its minimum economic impact on the public. Mitigating measures for this proposed action, primarily to ameliorate construction impacts, are discussed in Chapter 7.

Expansion of the JWPCP

Primary environmental motivation for construction of improvements to the existing plant is in the improvement of downstream water quality in the lower Truckee River. Phosphate loading is the particular quality factor on which mitigation is mandated by the NPDES permit for future plant operation.

Expansion of the plant capacity from 20 MGD to 40 MGD as proposed in the facilities plan, and justified in terms of both 20 year planning horizon and cost-effectiveness, has significant ability to accommodate future growth. Consequently, the secondary population-related impacts of treatment plant expansion are of real concern particularly from the standpoint of air quality maintenance in the service area. Since the special reason for public investment in the JWPCP is environmental protection related to water quality and quantity, a series of findings in these regards has been made. They are:

1) Flow in the lower Truckee River below Truckee Meadows will not be appreciably affected by the direct or indirect (population accommodation) impacts of treatment plant expansion.

2) With the exception of phosphorus, all other pollutant parameters will increase as the result of increased treated wastewater discharges to the lower Truckee River although none of those parameters are expected to exceed state standards as the result.

3) In regard to the fishery in the Truckee River, reduction in phosphorus loadings and reduction in inflow of agriculturally used surface water will be beneficial while increases in loading rates for other pollutants as the result of increased wastewater flows and non-point source urban runoff are adverse. Ammonia and chlorine loadings, in particular, will approach levels identified as toxic to certain fish species. However, in-situ confirmation of the combined impact of temperature and pollutant concentration is imperative before the significance of the fishery impact can be quantified and appropriate standards set for the Truckee River reaches.

4) The treatment plant upgrading proposal which offers the highest degree of phosphorus reduction and, thus, the maximum water quality benefit is the preferred alternative.

It is concluded that the short term construction impacts are modest and are outweighed by the long term benefit of reduced phosphorous concentrations in the Truckee River. It is also concluded that the treatment capacity planned is compatible with the population and land use changes previously approved as part of the area's overall general plan program, and as a continuation of the historic growth patterns which can be reasonably expected to occur in the future.

Cost factors and the potential for land reclamation through beneficial agricultural use as the result of spray irrigation of sludge and supernatant argues for the export concept to Spanish Springs Valley. The alternative involving the minimum diversion as well as the minimum air quality impact and lowest energy/chemical input is preferred. Consequently, Concept I, Alternative 3H is the recommended action and involves expansion of the conventional activated sludge treatment process to 40 MGD capacity; tertiary utilization of the PhoStrip process to reduce phosphorus concentrations in the effluent discharged to the Truckee River; and export of 1,200 acre-feet per year of sludge and phosphorus-rich supernatant to the land reclamation site in Spanish Springs Valley for irrigation. Chapter 7 will focus on mitigating measures for this proposed action.

Lawton-Verdi Sewer

In the case of the Lawton-Verdi Sewer, the reason for action is to eliminate the surface water pollution potential related to the existing independent sewerage facilities and independent septic tanks, thus protecting Truckee River water quality and the major domestic water supply source for the Cities of Reno and Sparks. Accommodation of future growth in the Verdi-Lawton corridor is clearly a purpose of this facility and possible tradeoffs with growth options in other parts of Truckee Meadows have been identified as an impact of this sewer construction. Cost-effective justifications apply to the sewer line sizing. Short term environmental impacts due to construction are balanced by long term protection of surface water quality which in turn is offset by increased non-point source pollution from increased urban runoff. Development west of Reno could occur without adversely affecting water quality. This development would need to be subjected to rigid controls and detailed planning. It is possible that a low density rural development in this area would prove some environmental benefits as opposed to a higher density urban development.

The proposed project is that of sewer construction on the railroad route (Alternate 2) to Lawton and no action at this time on the continuation of the sewer construction to Verdi. This alternate minimizes environmental impacts, primarily by reducing construction in the riverway and floodplain and by eliminating intrusion into archaeologically sensitive areas, is accommodated to a greater degree by a previously man-impacted right-of-way, and appears to offer less short term cost impacts. The goal of concentrating future growth around the existing urban core where services are available is clearly served by selecting the no project alternate beyond Lawton at this time. Mitigating measures for this proposed action should be directed toward minimizing short term construction impacts and the long term consequences of increased urban runoff and are discussed in Chapter 7.

CHAPTER VII

UNAVOIDABLE ADVERSE IMPACTS AND MITIGATING MEASURES

In many cases the primary and secondary adverse impacts for the proposed alternative are unavoidable. Some adverse impacts can be reduced in severity through the application of mitigative measures taken to offset an action's adverse effects. Other impacts cannot be mitigated.

It should be noted that the full project impact does not necessarily occur the day the facility becomes operable. This is particularly true for impacts that are associated with population growth.

For example, water quantity entering the newly completed plant will not be substantially different than that occurring today. The recognition of this concept is important because a vital aspect of the mitigative measures, as noted below, is the establishment of monitoring programs to collect sufficient, pertinent data. This data will be used to more precisely establish baseline conditions, to determine potential impacts on ecosystems and to select the best mitigative measures. Should appropriate monitoring programs be initiated in the near future, there is still sufficient time to gather needed information to support selection and implementation of the best mitigative measures without further endangering sensitive environmental and economic systems because of project operation.

The following discussion on unavoidable adverse impacts and feasible mitigating measures is divided into four sections: 1) impacts of construction activities; 2) impacts of operating the new facilities; 3) secondary impacts indirectly related to the project; and 4) the implementation of mitigative measures.

CONSTRUCTION

At the site environs, temporary increases in suspended particulate concentrations resulting from construction activities at the following locations will have short term impacts: plant expansion, land irrigation and land disposal sites and the areas along the pipeline routes including the Cross-Town Interceptor. Although concentrations and levels of exhaust emissions from construction equipment should not be sufficient to exceed air quality standards, certain mitigating measures can be taken to minimize levels of air pollution during construction:

Construction contracts can specify dust suppression measures (e.g., watering construction roads) and traffic volumes on dirt or gravel roadways. Restrictions can be put on equipment that is not operating properly to reduce excessive engine exhausts. Additional specifications can limit construction areas to a minimum and provide revegetation, where feasible, of all disturbed areas to limit wind and water erosion. The importance of minimizing sources or erosion and sediment loading in the Truckee River was discussed in Chapter 3. Recommended means of mitigating these sources of impact include:

1) keeping area of disturbance to a minimum: for example, constructing all pipelines across the river perpendicular to the river banks to minimize the area of stream substrate and number of aquatic organisms affected

2) avoiding river bank disturbance where possible

3) revegetating or stabilizing construction areas on disturbed river banks

4) restricting stream bottom substrate disturbance at points of river crossing to a minimum width

5) restricting pipeline stream-crossing construction during the period of extreme low flow (around August) and during the spawning period for the Lahontan cut-throat trout (March to June) in order to prevent damage resulting from sediment loading to young trout and eggs.

6) completing pipeline stream crossings within the minimum time period possible to minimize the period of sediment disturbance

7) preventing entry into surface waters of wash from equipment and waste materials such as petroleum products

Archaeological sites have been identified at the land disposal site in Spanish Springs Valley and along the west side of Spanish Springs Road. It is recommended, therefore, that an archaeological survey be conducted of the proposed land disposal site in Spanish Springs Valley to determine the importance of these sites, and that the sludge and supernatant

pipeline to Spanish Springs Valley be located on the east side of the Spanish Springs Road, and in the public right of way for road or ditch, in which case no survey would be required. If a route other than this is chosen as the pipeline route, then an archaeological survey should be conducted to properly choose the best location for the pipeline route.

Construction contracts should specify that any uncovering of significant archaeological sites be reported immediately and that work be halted to determine the proper course of action.

In order to minimize construction effects upon terrestrial vegetation and wildlife, the pipeline construction corridors should be kept to a minimum width. Construction equipment should have properly maintained and effective exhaust muffling to minimize noise disturbance. Construction refuse (e.g., cleaning materials, tanks, drums) must be disposed of at proper disposal sites. Temporary sanitation facilities should be removed from the construction site as construction progresses.

Construction activity, especially for the Cross-Town Interceptor, will disrupt traffic flow and increase traffic congestion. Traffic and pedestrian control and other related activities will be governed by standard procedures including those delineated through applicable EPA regulations (General Conditions of the Contract Documents of Federally Assisted Water and Sewer Projects and Supplementary Conditions, Appendix C-2) and OSHA regulations (OSHA - Nevada Industrial Commission).

Under the proposed alternative, construction will unavoidably require about 5 acres of land immediately adjacent to the plant that will not be available for other uses for the life of the project. This land is disturbed terrestrial habitat. Similarly, an area of sagebrush scrubland of approximately 775 to 1,500 acres will be removed from the terrestrial habitat of Spanish Springs Valley in order to construct the land irrigation site. This area will be enclosed and used for agricultural production of one or more domestic crops.

OPERATION

At the land treatment site, excessive nitrates and heavy metals, odor and disease contaminants are potential problems that may develop. Nitrates may leach from the irrigation site and cause eutrophication in Spanish Springs' ponds or excessive concentration in nearby wells. The sludge and supernatant will contain heavy metals that could, over a number of years,

accumulate in the upper soil horizons to eventually become toxic to plant growth. If sufficient aeration of the sludge and supernatant holding ponds does not occur, and if the sludge is not adequately mixed with the soil during land application, odor problems could develop. Finally, the sludge and supernatant may contain viable disease vectors that could create a health hazard.

Site-specific data that would unequivocally determine the actual potential or occurrence of the following phenomena is not available: 1) the leaching of nitrates into the groundwater and wells; 2) the accumulation of heavy metals that are toxic to plants; and 3) the health hazard of the waste. Therefore, as part of the mitigating measures, it is recommended that a continuous monitoring program consisting of soil testing, groundwater monitoring and control of conditions leading to surface runoff be initiated. Automated soil monitoring devices are commercially available. These permit early detection (6 months to a year) of soil leachate chemistry before the soil solution reaches the groundwater. Thus, the actual impact from application of sludge and supernatant can be determined before the groundwater is affected. Plant nutrition analysis techniques are also available. These techniques can be used to adequately monitor the effect of the sludge and effluent on the vegetation and, using available technology, the health hazard of the sludge and supernatant can be determined. By applying standard principles of sanitary engineering for pH control or to avoid anaerobic conditions, as examples, odors can be mitigated at the Spanish Springs Valley site.

If the sludge and supernatant that is transported to the Spanish Springs land disposal site (at 40 MGD wastewater flow to the plant) were applied to obtain 400 lbs/acre-yr nitrogen loading rate, then an additional 5,000 acre-ft/yr of water would be required for the production of local crops. This water could be obtained, in part, from the groundwater resources at the site, from Orr Ditch, or from the Truckee River. Such water losses would constitute a minor adverse impact upon the available water supply of the service area and upon Pyramid Lake water volume if the supplementary water is removed from the Truckee River. This water loss to the Pyramid Lake system would result in a slight adverse effect on the biological communities of the lake environs including the threatened Lahontan cutthroat trout and endangered Cui-ui populations.

The more favored land treatment modification under the chosen alternative (3H) is the combinations of land treatment with

the dried sludge being made available for use by residents of Reno and Sparks. This type of program would reduce the quantity of waste material applied in land treatment and the amount of supplemental water needed for the production of crops. The actual reduction in water use would depend on the demand for dried sludge.

From the available data, it appears that to utilize the sludge and supernatant as a resource will require the unavoidable commitment of additional land and water.

In the Truckee River reach below the expanded JWPCP's outfall certain water quality parameters (nitrate and chloride) may exceed state standards at low river flow and at maximum wastewater flow (40 MGD). Under these conditions, it is also anticipated that ammonia and residual chlorine will increase, but no state standards exist for these substances. Ammonia and residual chlorine could reach concentrations toxic to freshwater organisms. Data required to unequivocally support this conclusion is not currently available. The Nevada Environmental Protection Service has initiated a program of water quality monitoring and bioassay studies to establish existing pollutant loads, a reliable data base and the current impact of river pollutants on the Truckee River fishery. A water quality monitoring program should also be conducted during the operation of the facility to establish existing operating levels of ammonia and residual chlorine and chloramine. The conclusions of these studies should determine the need and type of mitigative measure to reduce levels. Potential mitigative measures are:

1) Supplement wastewater treatment with a nitrification process. The current facility design is such that no redesign of the existing plant will be necessary, but rather can be constructed as an "add-on" facility.

2) Supplement wastewater treatment with a dechlorination unit. This unit is fairly inexpensive (capital costs and annual operation and maintenance) and should be added prior to plant operation.

3) Increase effluent wastewater treatment retention time utilizing on-site storage facilities.

Because of the extreme toxicity of residual chlorine to aquatic organisms and the high probability of toxic concentrations existing in the effluent discharged to the Truckee River, it is strongly recommended that dechlorination be part of the waste treatment process.

It is highly probable that baseline and monitoring studies will show that ammonia concentrations in the Truckee River are, and will continue to be during plant operation, at levels toxic to aquatic organisms; therefore, nitrification will probably be necessary.

The installation of the proposed diffuser system in the Truckee River will facilitate mixing but it may also develop a chemical barrier to the passage of fish. To mitigate this potential impact, it would be best to use a diffuser system that does not exceed 25 percent of the cross-section width of the river at the point of discharge, or continue to discharge into Steamboat Creek.

In general, the degree of adverse impact to the Truckee River and the Spanish Springs land treatment site resulting from project operation is associated with the quantity of wastewater treated and waste discharged. A water conservation incentive program could substantially reduce water use, thus hydraulic loadings on the treatment plant and, consequently, environmental impact resulting from project operation.

The Cities of Reno and Sparks currently have a flat water rate charge system as opposed to a metered system. The Washoe County Blue Ribbon Task Force Committee (B-1) reported that water use in the Reno-Sparks area is nearly 50 percent greater than that of the average of other western cities with metered systems (see Table 7-A). To change from a flat rate to a metered system, however, would require a change in state law. The pipeline, particularly in river crossing areas, should be the subject of an annual surveillance and inspection program to spot damage or potential failure of the system.

SECONDARY IMPACTS

The expansion of sewage handling facilities and the upgrading of treatment capabilities at the JWPCP can be expected to accommodate the area's growth and urbanization rate. As a result, certain air pollution trends will probably continue and other secondary adverse impacts might occur.

Localized carbon monoxide concentrations from vehicular traffic may exceed state short term standards until at least 1980, particularly in downtown Reno. Incineration and open burning in the area can be expected to increase slightly. The productivity of batch plants (i.e., asphalt producers) and other smoke-producing industry will probably increase along with the rate of urbanization and development. New industry may be drawn to the area due to certain tax advantages and a growing labor force. Traffic congestion will increasingly become more complex and widespread. Nitrogen oxide emissions

TABLE 7-A

COMPARATIVE WATER USE STATISTICS
(gal/day per customer)

Flat Rate	Average Annual	Max. Day	Max. Day to Avg. Annual	Average (Annual) (gpcd)
SPPCo. 10 year Average 1963-1972	1,212	2,640	2.15	335
Stead-SPPCo. 1972	--	--	3.36	280
Great Falls, MT (S. Side)	535	1,415	2.64	134
Denver, CO 4th & Milwaukee	747	2,469	3.31	197
Metered System				
Hidden Valley 1972-1973	--	--	2.2	252
Mean west cities	458	979	2.12	123
Mean east cities	310	786	2.52	76

Source: (B-1)

are expected to increase, and violations of photochemical oxidant standards will continue to occur, possibly until at least 1995. During the winter, there will be a greater demand for sand to be applied to highways. Continuing and increased demands for sand and gravel from area plants will result in increased suspended particulate concentrations. The urban area will continue to encroach upon riparian and terrestrial habitats as a result of construction and human utilization. Increased water-related recreation will likely produce increased pressure upon aquatic habitats in the Truckee River. The following measures will potentially mitigate the above secondary adverse impacts.

Vehicular emissions of carbon monoxide, oxides of nitrogen, hydrocarbons, and sulfur oxides are the primary source of gaseous air pollutants in the Reno area. In the presence of sunlight, sulfur oxides, hydrocarbons and oxides of nitrogen combine to form photochemical oxidants. Mitigative measures to reduce ambient concentrations of these pollutants include:

1) a large-scale urban mass transit system

2) a vehicle inspection and maintenance program

3) traffic control plans for the central urban area

4) incentives for the use of other modes of transportation, including walking, bicycles, and motor cycles

A mass transit system has the greatest potential for producing a reduction of vehicular emissions. Costs of such a system are unavailable at this time, but a feasibility study is currently underway under the auspices of Washoe County (B-25). Currently, a small private busline provides limited service to Reno-Sparks. Vehicle inspection and maintenance is estimated to have the capability of producing at least a 10 percent reduction in emissions of hydrocarbons and carbon monoxide from late model cars (E-33). In Nevada, consideration of an inspection and maintenance plan for Reno-Sparks is the responsibility of the Nevada Environmental Commission (B-25). The effects of traffic controls (e.g., banning downtown traffic during certain hours), depend on the extent to which they might be instituted. Projections indicate that carbon monoxide emissions may be significantly reduced by 1981, through widespread use of late model cars equipped with efficient anti-pollution control devices (A-4). If mitigative measures cannot be implemented by that time, after 1981 they may not be absolutely necessary

to avoid violations of National Ambient Air Quality Standards (NAAQS) with respect to carbon monoxide. However, projections indicate mitigative measures would still be necessary to meet NAAQS for nitrogen oxides and photochemical oxidants. EPA Region IX requested the State of Nevada to revise the State Implementation Plan for control of carbon monoxide sources but, as of August 6, 1976, the Governor had not responded.

A recently authorized study of suspended particulate sources indicates that automobile traffic along unpaved roads and other automobile operations are a primary source of this man-made pollutant (P-8). Other sources include incineration, storage of sand and gravel, and construction (P-8). PEDCo, the authors of the study, is under contract to develop control strategies by October 1976 (F-14). Mitigative measures capable of reducing ambient concentrations of suspended particulates include:

1) paving and right-of-way improvements on unpaved roadways

2) speeding regulations on unpaved roadways

3) chemical treatment of unpaved roadways

4) elimination of most open burning

Paving and right-of-way improvements are estimated to be 85 percent effective in controlling emissions from these sources. However, the cost is considerable - $20,000 to $26,000 per mile (P-34). Speed control seems to be the most practical, cost-efficient means of controlling dust emissions along unpaved roads, although the efficiency of this measure is only 25 to 40 percent (P-34). Chemical treatment is estimated to be 50 percent efficient, at a cost of $8,500 to $14,000 per mile (P-34).

Air Pollution Control Regulations issued by the Washoe County District Health Department (WCDHD) in 1973 currently provide for the review of all new and existing single air pollutant sources (H-19). The WCDHD can refuse to issue an operating permit if the source cannot be operated in compliance with all existing state and federal laws or if the source will interfere with the compliance or maintenance of NAAQS. WCDHD regulations require that all reasonable precautions be taken to reduce emissions from construction, mining, or processing of sand, gravel, and rock. With certain exceptions, open burning is prohibited. The storage, loading and unloading of gasoline and other petroleum products is also regulated. Currently, periodic cleaning of paved streets in Reno and

Sparks is conducted by the Reno Public Works Department and the Sparks Public Works Department, respectively (B-25).

The encroachment upon outlying areas of Reno-Sparks due to urbanization and other development should be restricted to protect the more environmentally sensitive sections, such as the riparian strip of terrestrial habitat bordering the Truckee River. The Open Space Plan, which includes the Truckee River Greenbelt, should provide protection for much of the existing natural riparian habitats. The responsibility of recommending lands for acquisition rests with the Truckee River Advisory Board, who reports to the City Council (C-1).

The population growth projected for the Reno-Sparks service area will result in changes in land use patterns, particularly in peripheral urban expansion. This could be mitigated by the careful implementation of land use plans designed to direct development practices and reduce the potentiality of adverse impacts on local environments. The land use plans for the Reno-Sparks Metropolitan Area are incomplete at this time. The completion, acceptance and close adherence to these plans by local government would mitigate the impacts of population growth and urbanization that could proceed uncontrolled without a plan, resulting in regional implications in the areas of water quality, air quality, aesthetics and transportation, as well as in additional areas.

Careful planning and design of urban developments should include considerations for controlling urban runoff and surface contaminants to reduce non-point source pollution to the Truckee River. Control measures to reduce the pollution potential of urban runoff include public education, increased street sweeping programs, detention basins with operational design to reduce discharge of bottom sludges, roof drainage controls to reduce overloading of sewers, ordinances to control litter, feed lots, kennels, etc. Enforceable land use plans and detailed design criteria for construction of new urban areas could reduce pollution from urban runoff. As the urban areas in the service area increase in extent, the impact of the runoff on the Truckee River below the Reno-Sparks area will increase. Therefore, mitigative measures become more important as the urban areas increase in size.

IMPLEMENTATION OF MITIGATIVE MEASURES

The mitigative measures associated with the construction and operation of the proposed wastewater treatment program can be

implemented through the inclusion in construction contracts, specifications regarding the maximum width of disturbance for pipelines, restoration and revegetation of disturbed areas, equipment care, etc.; and the design and implementation of monitoring programs for the land treatment site and the Truckee River. The authority to implement these measures lies with the applicant.

Implementation of the following measures will mitigate the potential adverse geologic and seismic impacts reported in Chapter 6, which affect the treatment plant expansion, sludge and supernatant transmission pipelines and the interceptor sewer lines.

1) Install the sewer line with reasonable setback distances from the top of hills and banks

2) Design the sewer line and its appurtenances with reinforcement as necessary to reset earthquake forces

3) Provide periodic maintenance, surveillance, and quality control during construction as well as during normal systems operation

4) Proper monitoring could identify pipe settlement and allow for correction prior to any breakage. Frequent installation of valve structures along the transmission line would provide emergency shutoff locations

5) Design slopes properly to avoid possible landslides at the treatment plant site

6) The effects of expansive soil conditions can be minimized by placing a thicker than normal bed of ground below the pipe or by installing the pipeline at greater than minimum depth requirements

7) Exposure of all sewer lines under the river due to scour can be avoided if the pipe design requires adequate cover below the river bed

8) Damage to the interceptor sewer from landslides in the Lawton-Verdi area can be prevented by proper route selection surveys to avoid unstable areas with potentially unstable material

The secondary effects of the proposed alternative are associated with the population growth projected for the service area and are, for the most part, regulated by county and state agencies. For instance, air and water quality standards are set by the State of Nevada and the county and state have permit requirements that regulate air and water pollution from most point sources. However, the Cities of Reno and Sparks have authority to implement certain mitigative measures that can contribute significantly to pollution abatement. Land use planning, urban mass transit, traffic control plans, and regulation of urban design all have the potential for reducing local pollution. To date, the cities have implemented the following measures to mitigate the adverse effects of urban areas on local air and water resources (affected pollutants are given in parentheses):

1) Requiring that areas undergoing construction be watered for dust control during construction activities - streets, sewers, subdivisions, etc. (suspended particulates)

2) Adopting State of Nevada, Cities of Reno and Sparks and Washoe County insulation codes to reduce heat losses and fuel consumption (all pollutants)

3) Encouraging the use and partial subsidizing of public bus transportation (all pollutants)

4) Planning for adequate street and road systems to provide for more free flow of traffic, thereby reducing vehicular emissions. Planning is done by Truckee Meadows urban transportation study planning committee (a cooperative effort of Reno, Sparks and Washoe County). Through the county option gas tax, the street and highway commission provides funding for major arterials to implement this planning (all pollutants)

5) Sponsoring an air quality monitoring program in Washoe County; CPT index is broadcasted to the public daily to direct attention to the more serious air pollution problems and to solicit the public's cooperation (all pollutants)

6) Controlling open burning by allowing it only by permit on a very limited basis - a cooperative effort between the Reno, Sparks and Washoe County Fire Departments and the Washoe County Air Pollution Control Officer (hydrocarbons, particulates, oxidants)

7) Limiting solid waste disposal to sanitary landfill rather than burning. Private garbage collection firms are franchised by Reno, Sparks, and Washoe County (hydrocarbons, particulates, oxidants)

8) Utilizing special connection equipment to minimize fumes to the atmosphere in the delivery of bulk petroleum products to storage facilities, both wholesale and retail (hydrocarbons, oxidants)

9) Implementing street cleaning programs in both cities to reduce particulate levels (particulates)

10) Implementing a bicycle path master plan in Reno to reduce auto usage (all pollutants)

11) Enforcing pollution control equipment usage on equipment and plant operations in Reno, Sparks, and Washoe County, including concrete, aggregate, asphalt and central heating plants, cleaning establishments, incinerators, etc. (all pollutants)

12) Requiring building permits for any excavation and/or grading in the cities and county to control the suspension of particulates in the air (particulates)

13) Prohibiting visible vehicle emissions in Reno, Sparks and Washoe County (particulates, nitrogen oxides)

14) Gases produced from sludge waste are used within the plant to fire boilers necessary for sewage treatment and fuel for the heating-air conditioning system for the Administration Building at the plant site (oxides of sulfur and nitrogen)

15) Blowers and pumps planned within the treatment plant expansion will be propelled by sludge waste gas. It is also planned to install a sludge gas storage tank to possibly remove the need for the open burner or, at least, minimize the need substantially (oxides of sulfur and nitrogen, carbon monoxide)

16) In 1972, a plan was prepared by the State of Nevada for the Environmental Protection Agency. The northern section of Nevada (Reno-Sparks Metropolitan Area) air quality control region has been designated as an Air Quality Maintenance Area for Particulates (AQMAP) by the USEPA. An Air Quality Maintenance Plan is presently under preparation by the State of Nevada (particulates)

17) WCAP Regulations, Chapter 040.030, address guidelines for construction, mining and/or processing of sand, gravel, or rock (particulates)

18) Chapter 7.01 of the Reno Municipal Code, adopting standard specifications for public works construction and providing for watering procedures in an effort toward dust control during construction of streets, roads, sewers, subdivisions, or any other project (particulates)

19) Reno, Sparks and Washoe County Departments of Health solicited the support of local businessmen to develop a Clean Cities Program. This active committee, named Upkeep, has but one goal - to reduce litter (all pollutants).

20) The Cities of Reno and Sparks, as well as Washoe County, created and established the Regional Street and Highway Commission. Through the collection of a tax on local gasoline sales, major arterials have been funded for construction. In conjunction with the State of Nevada Highway Department, the Washoe County Area Transportation Study Committee (WCATS) was established to address urban transportation planning for adequate street and road systems to aid in reducing traffic congestion and provide for a more free flow of traffic to reduce pollutants from vehicular sources (all pollutants)

21) The Planning Commission has applied sound zoning principles and has achieved an organized and balanced Master Plan for the Metropolitan Reno-Sparks Area (all pollutants)

22) Water conservation practices should be considered for implementation. If such practices are used, BOD concentrations will be increased, and the facility design should take this into consideration.

The EPA has identified specific problems relating to ambient concentrations of particulates and carbon monoxide. Possible control strategies for particulates are presented in Table 7-B. In Table 7-C, possible control strategies for carbon monoxide and other transportation-related pollutants are described, with comments as to their efficiency and social acceptability.

TABLE 7-B

CONTROL TECHNIQUES FOR FUGITIVE DUST SOURCES

Source	Practicality of Regulation[a]	Control Method	Control Efficiency (percent)	Cost
Unpaved Roads	2-3	Paving and right of way improvement	85	20,000-26,000/mile
	4	Surface treatment with penetration chemicals	50	8,500-14,000/mile
	3	Soil stabilization chemicals worked into the roadbed	50	5,000-12,000/mile
	1-2	Speed control	25 mph-25% 20 mph-35% 15 mph-40%	
Construction Activity	1-2	Watering	50	2-5/acre
	2	Chemical stabilization of completed cuts and fills	80	150-400/acre
	3	Treatment of temporary access and haul roads on or adjacent to site	50	1,000-2,000/mile
		Minimal exposure periods (controlled by permit; good practice with watering or chemical stabilization)		?
Agriculture	3	Continuous cropping	25	Variable
	3	Limited irrigation of fallow fields	20	4-10 acres/year
	5	Restricting number of acres under tillage	-	No data
	5	Windbreaks	5	No data
	5	Inter-row plantings of grain on widely spaced row crops	15	No data
	5	Stubble, crop residue, or mulch left on fields after harvest for wind protection	10	No data
	5	Spray-on chemical stabilization	40	25-50/acre/application
Tailings	2	Chemical stabilization	80	250-750/acre
Pile	2-3	Vegetation	65	200-1,750/acre
	2	Combined chemical-vegetative stabilization	90	120-270/acre
Aggregate Storage	2	Continuous spray of chemical on material going to storage piles	90	20-50/1,000 tons
	1-2	Watering of haul roads and storage areas	50	2-5/acre
	3	Treatment of haul roads and traffic areas	50	1,000-2,000/mile
	2	Watering (sprinklers or truck)	80	2-5/acre
Cattle Feed Lots	5	Manure scraping	80	
	4	Chemical stabilization and water alone	40	25-50/acre/application

NOTES: (a) 1 = Excellent; 2 = Good; 3 = Fair; 4 = Poor; 5 = Not Recommended

Source: (E-44)

TABLE 7-C

POSSIBLE CONTROL STRATEGIES FOR REDUCTION OF EMISSIONS RELATED TO AUTOMOBILE OPERATIONS

Strategy	Comments
1) Federal Motor Vehicle Control Program	In progress. Significant reductions in emission rates of CO, HC, NO_x anticipated by 1985.
2) Retrofit Devices	Generally low social acceptability.
a) Vacuum Spark Advance Disconnect	Reduces CO emissions 9 percent, HC emissions 25 percent, NO_x emissions 23 percent. Applicable only to pre-1968 cars. Capital cost $20. Annual maintenance cost $5. Increases fuel consumption by 2 percent.
b) Air Bleed to Intake Manifold	Reduces CO and HC emissions 50 percent and 23 percent respectively. No effect on NO_x. Capital costs $20 - $60. Annual maintenance $7. Decreases fuel use by 4 percent.
c) Catalytic Converter	Reduces HC and CO emissions by 50 percent. Costs up to $200. Maintenance $12.50 per year. Requires lead-free fuel. Applicable to the majority of 1971-1974 year cars.
3) Inspection/Maintenance	Potential for reducing overall automotive emissions by 10 percent. Because it would probably involve a small inspection fee and necessitate maintenance costs of approximately $30 to $50, the social acceptability is limited.
4) Gaseous Fuel Conversion	Reduces HC and NO_x emissions from 1975 model cars by about 40 percent. Is particularly attractive to operators of fleets of vehicles, who may derive economic benefits from reduced fuel costs.
5) Evaporative Loss Control	Estimated 71 percent reduction in emissions from service station evaporative loss is possible. Capital and installation costs per service station are estimated at up to $12,000 per year. Presumably this increase in costs would be passed on to the consumer. Social acceptability moderate to low.
6) Traffic flow improvements to increase average speeds. (e.g., completion of Interstates, signal progression, one-way streets, reversible lanes, loading regulations, driver advisories, staggered work hours)	A trade-off relationship exists between lower CO and HC emissions at the expense of higher NO_x emissions. Impact in traffic flow improvements to increase average traffic speeds by 10 percent is judged to be minor. Social acceptability of such improvements, however, is for the most part high.
7) VMT Reduction Strategies	
a) Improved Public Transit	High potential for emission reductions, with high associated costs. Applicability at Reno reduced somewhat by high percentage of tourists.
b) Incentives to discourage automobile use	Efficacy related to degree of penalties involved. Penalties include high parking fees, increase in travel time. Because of the relative size of Reno and its dependence on non-resident tourist activity, discouraging automotive travel would probably meet with low social acceptability.
c) Auto-free Zones	Applicable only in Reno's downtown area.
d) Increased Parking Fees	Currently many automobile operators park free or for small charges. Very high charges, accompanied by very low social acceptability, would have to be instituted to cause an appreciable reduction in VMT.
e) Four-day Work Week	Estimated to have very minor potential for reducing VMT. Moderate to high social acceptability.
f) Gasoline Rationing	This alternative is not feasible unless accompanied by alternate means of transportation.
g) Exclusive Bus and Carpool Lanes	Should be accompanied by mass transit; applicability in Reno area currently unknown.

Source: (E-41, E-42, E-43)

CHAPTER VIII

LOCAL SHORT TERM USES AND LONG TERM PRODUCTIVITY

The proposed project involves the use of resources which, once committed, foreclose the option for other uses; the project will create beneficial and adverse impacts, both long term and short term. The purpose of this EIS is to inform decision makers of the nature of these inevitable tradeoffs so they and the public may make and monitor the required decisions intelligently. This chapter presents the tradeoffs between beneficial and detrimental impacts, both short term and long term, of the recommended plan for each of the three projects; the JWPCP expansion, the Cross-Town (Mill Street Interceptor) Sewer extension, and the Lawton-Verdi Interceptor. In addition, the public health and safety risk of completing the project and of the no project alternative will be discussed. Finally, the important consideration of implementing the project now or in the future will be addressed.

The basis for the short term-long term impact analysis of the recommended plans is the detailed analysis of impacts presented in Chapter 6. At the close of this chapter, the recommended plans of action are given. The beneficial-adverse impact tradeoff incorporates available mitigating measures detailed in Chapter 7.

The beneficial-adverse and short term-long term impacts tradeoffs of the three projects are displayed in Table 8-A. For all environmental areas studied which have a significant positive or negative impact, a comparison can be made to determine the environmental enhancement and detriment in implementing the project. In the case of changes in land use and population, which are substantial, no determination is made as to the beneficial or adverse nature of these secondary effects. It is the related secondary effects, such as air pollution, traffic, etc., on which a judgment of beneficial or adverse impact is made. The analysis shows that the short term impacts are construction-related; the most important of these impacts are the potential short term impacts on aquatic fauna from siltation and the potential to damage or destroy archaeological resources, particularly along the Spanish Springs line route. Both of these impacts are sufficiently mitigable that serious damage can be avoided.

Long term impacts are, for the most part, a tradeoff between direct long term beneficial impacts and secondary adverse impacts. The three projects, on a whole, will improve the sewage collection and treatment system, improve upstream surface and groundwater

TABLE 8-Aa

COMPARISON OF SHORT TERM AND LONG TERM EFFECTS

Joint Water Pollution Control Plant	Locale of Effect[a]	Short Term Impacts		Long Term (Year 2000) Impacts	
		Beneficial	Adverse	Beneficial	Adverse
Surface Water Hydrology	R, LTR	-	-	Minor gain of 6,000 AF/YR downstream flow	Minor loss from basin of 6,200 AF/YR irrigation waters
Surface Water Quality	R, LTR	-	-	Reduce need for small treatment plants & septic tanks; reduce ag. waste runoff	Petrochemical components of runoff will increase with urbanization.
Phosphate		-	-	40% reduction in Phos.	-
Nitrate		-	-	-	50% increase - will not generally exceed standards
BOD		-	-	-	20% increase
TDS		-	-	-	10% increase
Chlorides		-	-	-	10% increase violations of standards or recommended concentrations will be more frequent
Ammonia		-	-	-	100% increase
Groundwater Hydrology	R, LTR	-	-	Create recharge & irrigation area in Spanish Springs	Possible unknown effects on basin groundwater
Groundwater Quality	R, LTR	-	-	Reduce number septic tanks, local treatment plants, agricultural chemical leachate	Introduced sludge to ground surface may leach to groundwater
Flora & Fauna	R, LTR	-	Potential for siltation disturbance of benthic & aquatic fauna during construction	Reduce eutrophication, algal productivity	Pressure for urbanization on flora & region, effect of urban runoff. Increased nitrogen - an algal nutrient; increase chloride & ammonia will have negative effect on aquatic fauna, including endangered species. Risk of nutrient loading of Spanish Springs Ponds. Alterations of floral communities in irrigation and recharge areas.
Recreation	R	-	-		Pressure on national, state, local parks, wilderness areas.
Air Quality	R		Construction-related air pollutants		

TABLE 8-Ab

COMPARISON OF SHORT TERM AND LONG TERM EFFECTS
(Continued)

Joint Water Pollution Control Plant	Locale of Effect[a]	Short Term Impacts		Long Term (Year 2000) Impacts	
		Beneficial	Adverse	Beneficial	Adverse
Susp. Particulates		-	-		Slight increase in particulates
CO		-	-	Significant decline in CO levels	
Hydrocarbons		-	-	Significant decline in hydrocarbon levels	
NO_x		-	-	-	Possible significant increase in NO_x
SO_2		-	-	-	Slight increase, but future levels still low.
Oxidants		-	-	-	Slight increase
Demographics	R	-	-	Project will accommodate increase of 100,000 in population and 36,000 new homes	
Employment	R,S	Const. Employ. of 415 manyears	-	Project will accommodate urbanization expected to create 36,900 new jobs	-
Economics	R,S	Const. Payroll of $10.4 mil.	-	Earnings will increase by $1.3 billion	Debt servicing on $23 mil. with probable increase in fees & charges
Land Use	R,S	Changes in land use of Spanish Spring irrigation site from open range to crops		Conversion of about 25 sq. miles of land from non-urban to urban uses (compared to 25 sq. miles urban currently)	
Archaeology	S	-	Possible risk to archaeological resources in Spanish Springs	-	Pressure of urbanization resources in region
Soils, Geology Seismicity	S	-	-	-	Risk of slide or seismic damage to lines
Acoustics	S	-	Construction noise	-	Increased noise levels with urbanization
Scenic, Aesthetics	R,S	-	Construction activity	Reduction in visual water quality problems downstream, removal of sludge drying beds	Long term encroachment of urbanization on rural and natural scene.
Urban Systems Facilities	R,S	-	Minor traffic, utility facility disruption	Improvement in sewage collection & treatment system	Substantial indirect increase in demand for other systems
Services		-	-	-	Substantial indirect increase in demand for services
Energy		-	Energy consumption for construction	-	Indirect energy demand increase by 275%; direct energy consumption 11.75 x 10^6 kwhr

TABLE 8-Ac

COMPARISON OF SHORT TERM AND LONG TERM EFFECTS
(Continued)

Lawton-Verdi Interceptor	Short Term Impacts		Long Term (Year 2000) Impacts	
	Beneficial	Adverse	Beneficial	Adverse
Scenic, Aesthetic	-	Construction activity in scenic corridor	-	Trestle structures, manholes, benched & rip rap slopes etc; urbanization of Truckee Canyon
Recreation	-	Minor, aesthetic, fishing impact on recreation	-	-
Archaeology	-	Potential subsurface resources	-	Pressure of urbanization on resources in Truckee Canyon
Soils, Geology Seismicity	-	Potential for trench wall failure	-	Risk of seismic or slide damage to pipeline
Hydrology	-	-	-	-
Water Quality	-	Siltation at river crossing during construction	Improve water quality of upper Truckee River by reducing number of septic tanks & small treatment plants	-
Flora & Fauna	-	Siltation of river during construction	-	-
Air Quality	-	Construction-related air pollutants	-	-
Acoustics	-	Construction-related noise	-	-
Land Use	-	-	Project will facilitate urbanization of Truckee River Canyon and West Reno	
Urban Systems	-	Disruption of traffic, particularly Highway 40, during construction	Improve sewage collection system in Truckee Canyon	Energy necessary to operate lift stations estimated at $10,000 annually
Economics	Const. Payroll of $1.8 mil.	-	-	Debt Servicing on $4.0 million (to Lawton, only), with probable increase in fees and charges
Employment	Const. Employ. of 72 manyears	-	-	-

TABLE 8-Ad

COMPARISON OF SHORT TERM AND LONG TERM EFFECTS
(Continued)

Cross-Town Sewer Extension	Short Term Impacts		Long Term (Year 2000) Impacts	
	Beneficial	Adverse	Beneficial	Adverse
Scenic, Aesthetic	-	Construction activity	-	-
Recreation	-	Pipeline trenching through Wingfield Park & parallel another park; passes through Casino area	-	-
Archaeology	-	Potential subsurface resources	-	-
Soils, Geology Seismicity	-	-	-	Risk of seismic damage to lines
Hydrology	-	-	-	-
Water Quality	-	Siltation of Arlington Ave. Truckee River crossing during construction	Relieve at-capacity lines. Conduct sewage from upper Truckee Canyon to plant.	-
Flora & Fauna	-	Construction-related siltation impact on aquatic fauna	-	-
Air Quality	-	Construction-related air pollutants	-	-
Acoustics	-	Construction-related noise	-	-
Land Use	-	-	Project will accommodate urbanization of Northwest, West and downtown Reno, when linked to Lawton-Verdi Interceptor, it facilitates urbanization of the Lawton-Verdi corridor.	
Urban Systems	-	-		
Facilities, Utilities	-	Pipeline work close to in-place utilities, facilities	Relief of at-capacity and surcharged manholes in North Truckee Meadows Interceptor	-
Traffic	-	Temporary disruption during construction	-	-
Economics	Const. Payroll of $750,000	-	-	Debt servicing on $1.66 million, with probable increases in fees and charges
Employment	Const. Employ. of 30 manyears	-	-	-

NOTES: (a) R = Regional; LTR = Lower Truckee River & Pyramid Lakes; S = Site Environs

conditions and will reduce the phosphate levels and eutrophication of the Lower Truckee and Pyramid Lake system.

Secondary adverse impacts are all related to an increase in population and urbanization facilitated by the project. Several of the air quality and water quality parameters will increase as a result of future population levels. Future development will create new demands for urban systems, including facilities, utilities, services and energy. Urbanization will create pressures on the region's flora, fauna, archaeologic resources, scenic, park and open space system. Debt servicing for the project will probably require an increase in the user fees and charges.

The beneficial secondary impacts are the jobs created as a part of future urbanization and the total spendable income generated from this level of employment.

The three projects, themselves, represent a permanent commitment of resources of just under $30 million, in addition to about $1 million in annual O&M costs. No other direct commitment of resources is required. However, the facility will permit urbanization of approximately 25 square miles; this secondary effect, which is subject to project-by-project approval by elected officials and staff, will require the commitment of substantial resources in the future.

Health and safety are important from two aspects: construction workers and the public during construction; and long term operation of the facility. All construction involves some hazard, particularly to on-the-job workers. The construction to be undertaken to build the project is not particularly hazardous with the exception that some of the pipeline in the Lawton-Verdi area involves complex and dangerous construction in building trestles and trenching in potentially unstable ground. However, on-the-job construction supervision and advanced construction techniques are available to successfully mitigate this potential problem.

In the long run, the risk to public health from the project is minimal. The risk is greater from widespread use of septic tanks and local sewage treatment plants, which have the potential of contaminating both surface and groundwater supplies.

The project can be built according to the schedule outlined in the facilities plans (S-1, K-1), or it can be delayed and built later (other alternatives and their impacts were considered in Chapter 5 and 6). One reason to decide to implement the project at a later date is to await development of improved wastewater treatment technology. Another is to permit time for creation of alternate development policies regarding land use or use of a

limited resource, such as water. On the other hand, the treatment plant and one of the interceptors is at capacity now and either a condition of overload will occur with increasing frequency or a moratorium on sewer hookups will have to be implemented. The responsible public agency has decided there is compelling reason to implement the project immediately. Analysis of impacts of the no-project alternative supports this.

A ready comparison of the project versus the no project condition for all three projects is given in Figures 6-12 through 6-16 and Tables 6-S through 6-X. Individual parameters vary from project to project and each project has a different "project" versus "no project" impact pattern. On an overall basis however, the long term impacts of "no project" are substantially greater than implementation of the project.

CHAPTER IX

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction of sewage treatment and sewage conveyance systems requires the irreversible, irretrievable expenditure or use of energy, material, land and manpower and depreciation of capital goods (equipment). Construction also poses certain risks to the environment and to construction workers and residents, some of which may be irreversible.

Continued operation and maintenance of the sewage system and equipment requires expenditures of energy, materials, manpower and depreciation of capital.

Money is not discussed in the context of an irreversible or irretrievable resource because, strictly speaking, it represents a claim on more basic resources. Expenditure of funds represents a decision, at a particular time, to utilize specific resources in a given way as opposed to other uses.

CONSTRUCTION-RELATED RESOURCE CONSUMPTION

Material, energy, labor and right-of-way land resources required for the JWPCP, the Cross-Town Sewer (Mill Street Interceptor Extension) and the Lawton-Verdi Interceptor are represented by the capital costs of their respective alternatives, detailed in Chapters 5 and 6.

Joint Water Pollution Control Plant (JWPCP)

The recommended alternative for expansion of the plants (Concept I) will require an estimated 415 man years of construction labor. The materials, energy, labor costs, land, right-of-way and depreciation of equipment and buildings is represented in the capital costs of $23 million (K-1). Land required for the plant, about 5 acres, is owned by the city; its use is essentially an irreversible commitment to the proposed use. The transmission lines to the Spanish Springs Valley irrigation site will be placed for part of its length in the right-of-way of Spanish Springs Road, already committed to urban facility use. Right-of-way for the remainder will have to be purchased. The irrigation site will be purchased as part of the project. However, its use is more flexible and is not irretrievably committed to crop irrigation.

During construction, the potential for accidental irretrievable loss of certain resources exists. This risk primarily involves

construction of the transmission line across the Truckee River and along a route which contains numerous archaeologocial resources. Elsewhere in this report, it has been emphasized that care must be taken, particularly in river crossings, to use construction methods, materials, equipment and scheduling which avoid harmful effects on downstream biota and the potential for accidental spillage of construction chemicals, materials, fuel or lubricants, creating water quality problems. In the river bank area and along the transmission line, even where archaeologic resources have not been identified by surface reconnaissance, care must be taken in the event artifacts are uncovered, to halt work until a competent archaeologist can assess the value and required mitigation measure for the resource.

Cross-Town Sewer (Mill Street Interceptor Extension)

The Cross-Town Sewer, recommended Alternative AB-R, is estimated to require 30 man years of construction labor. The material, energy, labor costs, right-of-way and depreciation of equipment and buildings is represented in the estimated capital costs of $1.66 million (S-1). For the most part, existing street right-of-way will be utilized.

During construction, the potential for accidental loss of certain resources exists. The line crosses the Truckee River near Arlington Avenue and creates the risk of siltation, accidental spillage and damage to biota downstream. In the reach along the river route west of Washington Street there is the potential of uncovering archaeological resources during trenching operations. In this event, work should be halted until an archaeologist can assess the value of the resource and appropriate mitigation measures implemented.

Trenching and pipe laying in the street right-of-way will require careful supervision to avoid damage to existing energy, communication, water and sewer lines which pose a health risk to workers or civilians or involve loss of nonrenewable resources.

Lawton-Verdi Interceptor

The recommended Lawton segment of the Lawton-Verdi Interceptor is estimated to require 72 man years of construction labor. Materials, energy, labor costs, right-of-way and depreciation of equipment and buildings is represented in the capital costs of $4.0 million (S-1). This alternative will make use of an existing railroad right-of-way and, therefore, continuation of an existing use and commitment of the land resource.

Potential irreversible destruction of resources during construction is significantly lower for the selected route than for its alternatives and is considered minor. There is some potential for

uncovering subsurface archaeological resources and the standard precautions should be taken. The railroad route involves railroad track jacking, tunnelling, trestle construction and the potential for unstable soil conditions requiring shoring; these constitute fairly hazardous construction conditions for which appropriate caution should be taken in construction methods.

OPERATION-RELATED RESOURCE CONSUMPTION

After construction, further irreversible, irretrievable commitment of resources derives from three sources: 1) operation and maintenance (O&M) of the facilities; 2) the potential for accident or damage to the system; and 3) the indirect commitment of resources which is facilitated by the project.

Operation of the completed JWPCP of 40 MGD capacity is estimated to require 39 employees, in addition to agricultural specialists assisting at the irrigation site. Energy requirements are estimated at 11.75×10^6 kwhr annually.

The annual cost of electrical energy required to operate the lift stations of the total Lawton-Verdi line is estimated at $10,000 (S-1). Annual use of chemicals at the treatment plant is estimated at 12,650 pounds of lime. Once in place, such facilities are generally assumed to have an estimated life of 50 years (S-1). Thus, after the useful life of the facility, replacement, requiring commitment of additional nonrenewable resources, will have to occur.

During operation of the plant and collection system, operational or physical failure could occur (created by seismic stress, material failure, damage by construction crews or other causes) which may temporarily endanger water quality and downstream biota. Except for the manpower, materials and energy required for repairs, these potential accidents pose the risk for temporary impact only.

Operation of the plant and irrigation site offers the potential to create soil conditioner, a new resource, and crops, a direct consumable food supply (or indirect, if the crop is harvested for consumption by animals or if the hills are grazed by animals).

Urbanization facilitated by the project will require the irreversible, irretrivable commitment of substantial land, material, labor and energy resources and, for continual operation, labor, materials and energy. In the process, vegetation wildlife, scenic, archaeologic and recreational resources will be irretrievably consumed or lost. Current agricultural production will be irretrievably converted to urban uses. Water will be consumed at a greater rate, although it is a recycling resource. Water quality

will be affected variously, depending on the parameter, as a result of the project at full capacity.

In the absence of federally mandated exhaust system (mobile and stationary) improvements, the regional air quality would worsen. However, federal and state air quality policy is expected to have determining influence on air quality. The only effective local policy control over air quality is limitation on urbanization. In view of the federal air quality and emission standards, such a local policy implementation is not forced upon local decision-makers.

PART IV

SELECTED PROJECT, PUBLIC INPUT AND RESPONSE, APPENDICES AND BIBLIOGRAPHY

SELECTED PROJECT

To be prepared after public workshops.

PUBLIC INPUT AND RESPONSE

To be supplied after formal public hearing on the Draft Environmental Impact Statement.

APPENDICES

APPENDIX NO.		Page No.
1	NEVADA STATE AIR QUALITY CONTROL BOARD STANDARDS	A-1
2	VEGETATION	A-5
3	TERRESTRIAL AND AQUATIC FAUNA	A-11
4	AIR QUALITY ANALYSIS	A-15
5	TRUCKEE MEADOWS WATER BUDGET	A-29
6	TRUCKEE RIVER FLOW GAUGE DATA	A-39
7	RENO/SPARKS WASTEWATER TREATMENT PLANT DISCHARGE DATA	A-43
8	WATER QUALITY MODEL	A-47
9	NOISE LEVEL CALCULATIONS	A-53

APPENDIX 1

NEVADA STATE AIR QUALITY CONTROL
BOARD STANDARDS

TABLE 1-1

AMBIENT AIR QUALITY STANDARDS -
SPARKS, RENO, WASHOE COUNTY, AND STATE OF NEVADA

The following air contaminant concentrations shall not be exceeded at any single point in the ambient air:

Sulfur oxides as sulfur dioxide

Annual arithmetic mean	60 $\mu g/m^3$	(0.02 ppm)
Maximum 24-hour concentration	260 $\mu g/m^3$	(0.1 ppm)
Maximum 3-hour concentration	1,300 $\mu g/m^3$	(0.5 ppm)

Particulate matter

Annual geometric mean	60 $\mu g/m^3$
Maximum 24-hour concentration	150 $\mu g/m^3$

Carbon monoxide

Maximum 8-hour concentration	10,000 $\mu g/m^3$	(9.0 ppm)
Maximum 1-hour concentration	40,000 $\mu g/m^3$	(35.0 ppm)

Photochemical oxidant

Maximum 1-hour concentration	160 $\mu g/m^3$	(0.08 ppm)

Hydrocarbons (non-methane fraction)

Maximum 3-hour concentration between 6:00 a.m. and 9:00 a.m.	160 $\mu g/m^3$	(0.24 ppm)

Nitrogen dioxide

Annual arithmetic mean	100 $\mu g/m^3$	(0.05 ppm)

All values corrected to reference conditions.

Definitions:

$\mu g/m^3$ - micrograms per cubic meter
ppm - parts per million by volume

These ambient air quality standards are minimum goals and it is intended that they protect the existing quality of the air of the City of Sparks to the extent that it is economically and technically feasible.

Source: (H-10)

Preceding page blank

APPENDIX 2

VEGETATION

TABLE 2-1

VEGETATION OF THE LOWER TRUCKEE RIVER BASIN AND PYRAMID LAKE

Shrubs and trees

Antelope bitterbrush	*Purshia tridentata*
Desert bitterbrush	*Purshia glandulosa*
Burrobrush	*Hymenoclea monogyra*
Black cottonwood	*Populus trichocarpa*
Lombardy poplar	*Populus italica*
Western cottonwood	*Populus fremontii*
Nevada dalea	*Dalea polyadenia*
Green ephedra	*Ephedra viridis*
Nevada ephedra	*Ephedra nevadensis*
Desert gooseberry	*Ribes velutinum*
Black greasewood	*Sarcobatus vermiculatus*
Upland greasewood	*Sarcobatus baileyi*
Spiny hopsage	*Grayia spinosa*
Gray horsebrush	*Tetradymia canescens*
Littleleaf horsebrush	*Tetradymia glabrata*
Iodine bush	*Allenrolfea occidentalis*
Desert peach	*Prunus andersonii*
Prickly pear	*Opuntia* sp.
Jeffrey pine	*Pinus jeffreyi*
Single leaf pinyon pine	*Pinus monophylla*
Douglas rabbitbrush (green r.)	*Chrysothamnus viscidiflorus*
Rubber rabbitbrush	*Chrysothamnus nauscosus*
Baldhip rose	*Rosa gymnocarpa*
Sage	*Salvia dorrii*
Big sagebrush	*Artemisia tridentata*
Bud sagebrush	*Artemisia spinescens*
Silver sagebrush	*Artemisia cana*
Cudweed sagewort	*Artemisia ludoviciana*
Fourwing saltbush	*Atriplex canescens*
Shadscale saltbush	*Atriplex confertifolia*
Quailbush	*Atriplex lentiformis*
Saltcedar (tamarisk)	*Tamarix* sp.
Alkali seepweed	*Suaeda fruiticosa*
Willow	*Salix* sp.
Winterfat (white sage)	*Eurotia lanata*
Anderson wolfberry	*Lycium andersonii*

Forbs

Balsam root	*Balsamorhiza* sp.
Bassia	*Bassia* sp.
Bluebell	*Mertensia* sp.
Cocklebur	*Xanthium strumarium*
Daisy	*Aster* sp.
Desert trumpet	*Eriogonum inflatum*
Dock	*Rumex conglomeratus*
Duckweed	*Lemna* sp.
False toad flax	*Comandra pallida*
Fiddleneck	*Amsinckia* sp.
Filaree	*Erodium cicutarium*
Gray molly	*Kochia americana*
Gum plant	*Grindelia squarrosa*
Halogeton	*Halogeton glomeratus*
Hawksbeard	*Crepis* sp.
Indian paintbrush	*Castilleja* sp.
Knotweed	*Polygonum aviculare*
Lamb's quarters	*Chenopodium album*
Locoweed	*Astragalus* sp.
Lupine	*Lupinus* sp.
Mallow	*Malva* sp.
Marshelder	*Iva* sp.
Muskgrass	*Chara* sp.
Mustards	*Brassica* sp.

Preceding page blank

TABLE 2-1

VEGETATION OF THE LOWER TRUCKEE RIVER BASIN AND PYRAMID LAKE
(continued)

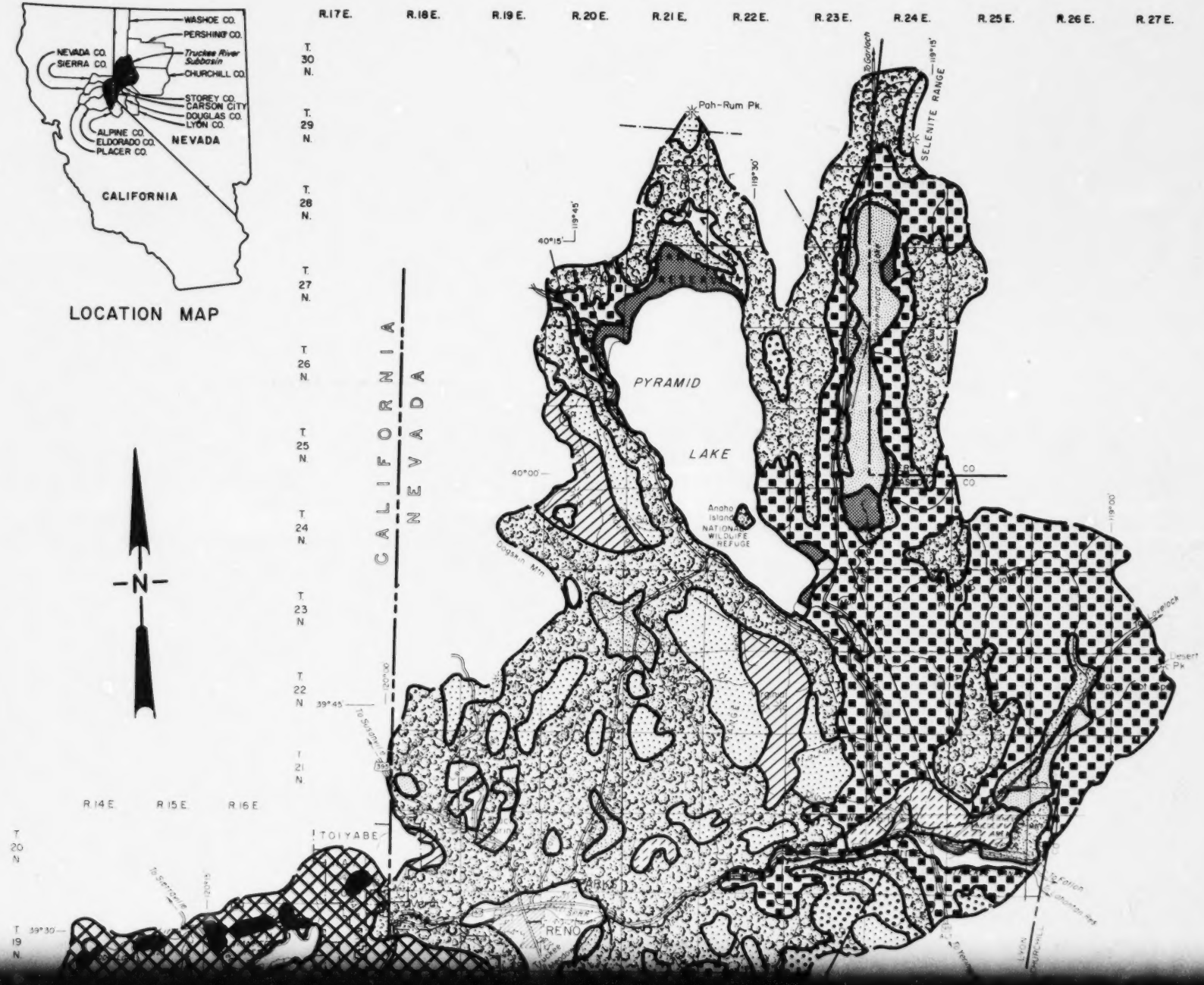
Peppergrass	Lepidium latifolium
Pepperwort	Marsilea mucronata
Phlox	Phlox sp.
American pondweed	Potamogeton nodosus
Curlyleaf pondweed	Potamogeton crispus
Horned pondweed	Zannichella palustris
Sago pondweed	Potamogeton pectinatus
Western pondweed	Potamogeton latifolius
Prickly poppy	Argemone sp.
Prince's plume	Stanleya pinnata
Evening primrose	Oenothera sp.
Tansy mustard	Descuriana sophia
Russian thistle	Salsola kali
Tumbleweed	Sisymbrium altissimum
Water fern	Azolla sp.
Water hemlock	Cicuta douglasii
Waterweed	Elodea sp.
Widgeongrass	Ruppia maritima
Yellow bee plant	Cleome lutea

Grasses and Grass-like Plants

Alfalfa	Medicago sativa
Nuttall alkaligrass	Puccinellia airoides
Alkali sacaton	Sporobolus airoides
Meadow barley	Hordcum brachyantherum
Big bluegrass	Poa ampla
Canby bluegrass	Poa canbyi
Nevada bluegrass	Poa nevadensis
Sandberg bluegrass	Poa secunda
Cheatgrass brome	Bromus techorum
Foxtail brome	Bromus rubens
Cattail	Typha sp.
Idaho fescue	Festuca idahoensis
Prairie junegrass	Koelaris cristata
Elmer needlegrass	Stipa elmeri
Lemmon needlegrass	Stipa lemmoni
Thurber needlegrass	Stipa thurberiana
Western needlegrass	Stipa occidentalis
Oniongrass	Melica sp.
Rabbitfoot grass	Polypogon monspeliensis
Indian ricegrass	Oryzopsis hymenoides
Baltic rush	Juncus balticus
Saltgrass	Distichlis stricta
Sedge	Carex sp.
Spikerush	Eleocharis sp.
Battlebrush squirreltail	Sitanion hystrix
Bluebunch wheatgrass	Agropyron spicatum
Creeping wildrye	Elymus triticoides
Great Basin wildrye	Elymus cinereus

Source: (A-1, K-3, F-11, I-1, R-22)

LOCATION MAP



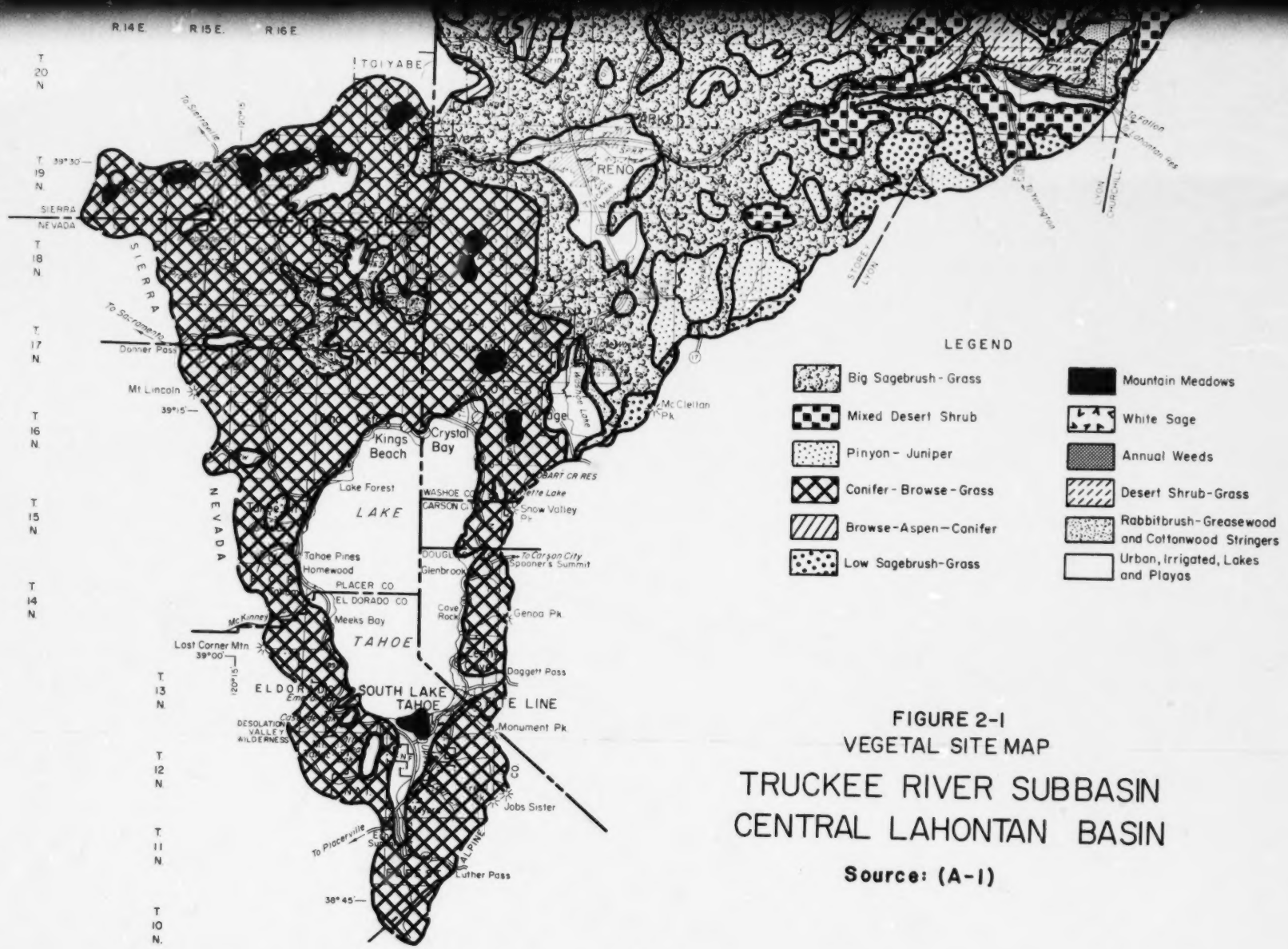


FIGURE 2-1
VEGETAL SITE MAP

TRUCKEE RIVER SUBBASIN
CENTRAL LAHONTAN BASIN

Source: (A-1)

APPENDIX 3

TERRESTRIAL AND AQUATIC FAUNA

Preceding page blank

TABLE 3-1

COMPOSITION OF ALGAE GENERA COLLECTED ON RIFFLE SUBSTRATE AT THREE LOWER TRUCKEE RIVER STATIONS DURING 1972

Division / Genus	Station 8 (Above Steamboat Creek) (%)	Station 9 (Above Derby Dam) (%)	Station 11 (About 7 Mi. Below Wadsworth, NV) (%)
CHLOROPHYTA			
Chlorella	.05		
Cladophora	6.25	10.60	44.0
Closterium	*	3.98	
Cosmarium		.28	*
Hyalotheca	*		
Microsema	3.98		
Nephrocytium	*		
Pandorhina			*
Pediastrum			*
Scenedesmus	4.00	2.60	5.25
Stigeoclonium		21.25	
CYANOPHYTA			
Anabaena	1.00		*
Merismopedia	*	*	*
Oscillatoris	15.25	6.65	2.68
Phormidium		.28	
Raphidiopsis			.25
Tolypothrix			*
Lynghya		2.50	
Xenococcus			.25
Aphanosapsa			.06
CHRYSOPHYTA			
Cocconeis	1.48	2.20	.28
Cyclotella	*		
Cymbella	11.20	2.10	.50
Diatoma	.90	5.55	26.00
Diploneis	.50	1.25	
Epithemia	1.00	1.28	
Fragilaria	.30	*	4.28
Gomphonema	13.40	4.00	6.10
Hantzchia	.28	4.13	.58
Melosira	6.63	7.10	3.23
Navicula	23.4	18.3	3.00
Nitzschia	.58	1.40	*
Rhoicosphenia	.50		.75
Ropalodia	3.76		
Stephanodiscus	.75	1.38	.85
Surirella	*	.25	*
Synedra	5.00	5.40	2.95

*Insignificant

Source: (E-2)

Preceding page blank

TABLE 3-2

WILDLIFE SPECIES KNOWN TO OCCUR IN THE
LOWER TRUCKEE RIVER BASIN-PYRAMID LAKE AREA

COMMON NAME	SCIENTIFIC NAME
MAMMALS	
Bats	
Yuma myotis	Myotis yumanensis
California myotis	Myotis californicus
Small-footed myotis	Myotis subulatus
Silver-haired bat	Lasionycteris noctivagans
Western pipistrel	Pipistrellus hesperus
Western big-eared bat	Plecotus townsendi
Pallid bat	Antrozous pallidus
Mexican freetail bat	Tadarida brasiliensis
Ringtail Cats and Raccoons	
Raccoon	Procyon lotor
Minks, Weasels, Badgers and Skunks	
Longtail weasel	Mustela frenata
Mink	Mustela vison
Badger	Taxidea taxus
Spotted skunk	Spilogale putorius
Striped skunk	Mephitis mephitis
Coyotes, Wolves and Foxes	
Coyote	Canis latrans
Kit fox	Vulpes macrotis
Cats	
Mountain Lion	Felis concolor
Bobcat	Lynx rufus
Squirrels	
Townsend ground squirrel	Citellus townsendi
Whitetail antelope squirrel	Ammospermophilus leucurus
California ground squirrel	Citellus beecheyi
Pocket Gophers	
Valley pocket gopher	Thomomys bottae
Pocket Mice, Kangaroo Mice and Kangaroo Rats	
Little pocket mouse	Perognathus longimembris
Longtail pocket mouse	Perognathus formosus
Pale kangaroo mouse	Microdipodops pallidus
Ord kangaroo rat	Dipodomys ordi
Great Basin kangaroo rat	Dipodomys microps
Desert kangaroo rat	Dipodomys deserti
Merriam kangaroo rat	Dipodomys merriami
Beaver	
Beaver	Castor canadensis

TABLE 3-2

WILDLIFE SPECIES KNOWN TO OCCUR IN THE
LOWER TRUCKEE RIVER BASIN-PYRAMID LAKE AREA
(continued)

COMMON NAME	SCIENTIFIC NAME
Mice, Rats and Voles	
Western harvest mouse	Reithrodontomys megalotis
Canyon mouse	Peromyscus crinitus
Deer mouse	Peromyscus maniculatus
Pinon mouse	Peromyscus truei
Northern grasshopper mouse	Onychomys leucogaster
Desert woodrat	Neotoma lepida
Bushytail woodrat	Neotoma cinerea
Mountain vole (Montane meadow mouse)	Microtus montanus
Longtail vole (Long-tailed meadow mouse)	Microtus longicaudus
Sagebrush vole	Lagurus curtatus
Muskrat	Ondatra zibethica
House mouse	Mus musculus
Porcupine	
Porcupine	Erethizon dorsatum
Nutria	
Nutria	Myocastor coypus
Hares and Rabbits	
Whitetail jackrabbit	Lepus townsendii
Blacktail jackrabbit	Lepus californicus
Mountain cottontail	Sylvilagus nuttalli
Pygmy rabbit	Sylvilagus idahoensis
Dear	
Mule deer	Odocoileus hemionus
REPTILES[a]	
Pacific terrapin	Clemmys marmorata
Western collard lizard	Crotaphytus collaris baileyi
Leopard lizard	Crotaphytus wislizenii
Great Basin horned lizard	Phrynosoma platyrhinos
Sagebrush lizard	Sceloporus graciosus
Great Basin fence lizard	Sceloporus occidentalis biseriatus
Great Basin uta	Uta stansburiana
Western blue-tailed skink	Eumeces skiltonianus
Great Basin whiptail	Cnemidophorus tigris
Western rubber boa	Charina bottae
Mormon racer	Coluber constrictor mormon
Great Basin striped racer	Masticophis taeniatus
Great Basin bull snake	Pituophis catenifer deserticola
Common garter snake	Thamnophis elegans
Red-sided garter snake	Thamnophis sirtalis
Great Basin rattlesnake	Crotalus viridis lutosus
AMPHIBIANS[a]	
Western toad	Bufo boreas
Pacific tree toad	Hyla regilla
Leopard frog	Rana pipiens
Northern bullfrog	Rana catesbeiana

TABLE 3-2

WILDLIFE SPECIES KNOWN TO OCCUR IN THE
LOWER TRUCKEE RIVER BASIN-PYRAMID LAKE AREA
(continued)

COMMON NAME	SCIENTIFIC NAME
BIRDS	
Loons	
Common Loon	Gavia immer
Grebes	
Horned grebe	Podiceps auritus
Eared grebe	Podiceps nigricollis
Western grebe	Aechmophorus occidentalis
Pied-billed grebe	Podilymbus podiceps
Pelicans and Cormorants	
White pelican	Pelecanus erythrorhynchos
Double-crested cormorant	Phalacrocorax auritus
Herons and Bitterns	
Green heron	Butorides virescens anthonyi
Great blue heron	Ardea herodias
Great egret	Casmerodius albus
Snowy egret	Egretta thula
Black-crowned night heron	Nycticorax nycticorax
Least bittern	Ixobrychus exilis
American bittern	Botaurus lentiginosus
White-faced ibis	Plegadis chihi
Swans, Geese and Ducks	
Whistling swan	Olor columbianus
Canada goose (western)	Branta canadensis moffitti
Canada goose (lesser)	Branta canadensis parvipes
Canada goose (cackling)	Branta canadensis minima
White-fronted goose	Anser albifrons
Snow goose	Chen caerulescens
Ross' goose	Chen rossii
Mallard	Anas platyrhynchos
Gadwall	Anas strepera
Pintail	Anas acuta
Green-winged teal	Anas crecca carolinensis
Blue-winged teal	Anas discors
Cinnamon teal	Anas cyanoptera
American wigeon	Anas americana
Northern shoveler	Anas clypeata
Wood duck	Aix sponsa
Red head	Aythya americana
Ring-necked duck	Aythya collaris
Canvasback	Aythya valisineria
Greater scaup	Aythya marila
Lesser scaup	Aythya affinis
Common goldeneye	Bucephala clangula
Barrow's goldeneye	Bucephala islandica
Bufflehead	Bucephala albeola
Surf scoter	Melanitta perspicillata
Ruddy duck	Oxyura jamaicensis
Hooded merganser	Lophodytes cucullatus
Common merganser	Mergus merganser
Red-brested merganser	Mergus serrator

TABLE 3-2

WILDLIFE SPECIES KNOWN TO OCCUR IN THE
LOWER TRUCKEE RIVER BASIN-PYRAMID LAKE AREA
(continued)

COMMON NAME	SCIENTIFIC NAME
Vultures, Hawks and Falcons	
Turkey vulture	*Cathartes aura*
Goshawk	*Accipiter gentilis*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Red-tailed hawk	*Buteo jamaicensis*
Swainson's hawk	*Buteo swainsoni*
Rough-legged hawk	*Buteo lagopus*
Ferruginous Hawk	*Buteo regalis*
Golden eagle	*Aquila chrysaetos*
Bald eagle	*Haliaeetus leucocephalus*
Marsh hawk	*Circus cyaneus*
Prairie falcon	*Falco mexicanus*
Merlin	*Falco columbarius*
American kestrel	*Falco sparverius*
Quails and Pheasants	
California quail	*Lophortyx californicus*
Ring-necked pheasant	*Phasianus colchicus*
Chukar	*Alectoris chukar*
Cranes, Rails and Allies	
Sandhill crane	*Grus canadensis*
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
Common galinulle	*Gallinula chloropus*
American coot	*Fulica americana*
Shorebirds, Gulls and Allies	
Semipalmated plover	*Charidrius semipalmatus*
Snowy plover	*Charidrius alexandrinus*
Killdeer	*Charidrius vociferus*
Mountain plover	*Charadrius montanus*
Black-bellied plover	*Pluvialis squatarola*
Common snipe	*Cappella gallinago*
Long-billed curlew	*Numenius americanus*
Spotted sandpiper	*Actitis macularia*
Solitary sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Greater yellowlegs	*Tringa melanoleuca*
Lesser yellowlegs	*Tringa flavipes*
Least sandpiper	*Calidris minutilla*
Dunlin	*Calidris alpina*
Long-billed dowitcher	*Limnodramus scolopaceus*
Western sandpiper	*Calidris mauri*
Marbled godwit	*Limosa fedoa*
Sanderling	*Calidris alba*
American avocet	*Recurvirostra americana*
Black-necked stilt	*Himantopus mexicanus*
Wilson's phalarope	*Steganopus tricolor*
Northern phalarope	*Lobipes lobatus*
California gull	*Larus californicus*
Ring-billed gull	*Larus delawarensis*
Bonaparte's gull	*Larus philadelphia*
Heermann's gull	*Larus heermanni*
Forster's tern	*Sterna forsteri*
Caspian tern	*Hydroprogne caspia*
Black tern	*Childonias niger*

TABLE 3-2

WILDLIFE SPECIES KNOWN TO OCCUR IN THE
LOWER TRUCKEE RIVER BASIN-PYRAMID LAKE AREA
(continued)

COMMON NAME	SCIENTIFIC NAME
Pigeons and Doves	
Mourning dove	Zenaida macroura
Cuckoos	
Yellow-billed cuckoo	Coccyzus americanus
Owls	
Barn owl	Tyto alba
Screech owl	Otus asio
Great horned owl	Bubo virginianus
Burrowing owl	Speotyto cunicularia
Long-eared owl	Asio otus
Short-eared owl	Asio flammeus
Saw-whet owl	Aegolius acadicus
Coatsuckers, Oilbirds and Allies	
Common nighthawk	Chordeiles minor
Swifts and Hummingbirds	
Vaux's swift	Chactura vauxi
Rufous hummingbird	Selasphorus rufus
Kingfishers	
Belted kingfisher	Megaceryle alcyon
Woodpeckers	
Common flicker	Colaptes auratus
Lewis' woodpecker	Asyndesmus lewis
Hairy woodpecker	Dendrocopos villosus
Downy woodpecker	Dendrocopos pubescens
Perching Birds	
Western kingbird	Tyrannus verticalis
Ash-throated flycatcher	Myiarchus cinerascens
Black phoebe	Sayornis nigricans
Say's phoebe	Sayornis saya
Western wood pewee	Contopus sordidulus
Olive-sided flycatcher	Nuttallornis borealis
Horned lark	Eremophila alpestris
Violet-green swallow	Tachycinets thalassina
Tree swallow	Iridoprocne bicolor
Rough-winged swallow	Stelgidopteryx ruficollis
Barn swallow	Hirundo rustica
Cliff swallow	Petrochelidon pyrrhonota
Scrub jay	Aphelocoma coerulescens
Black-billed magpie	Pica pica
Common raven	Corvus corax
Common crow	Corvus brachyrhynchos
Pinon jay	Gymnorhinus cyanocephalus
Mountain chickadee	Parus gambeli
Bushtit	Psaltriparus minimus
Red-breasted nuthatch	Sitta canadensis
Bewick's wren	Thryomanes bewickii
Canon wren	Catherpes mexicanus
Rock wren	Salpinctes obsoletus

TABLE 3-2

WILDLIFE SPECIES KNOWN TO OCCUR IN THE
LOWER TRUCKEE RIVER BASIN-PYRAMID LAKE AREA
(continued)

COMMON NAME	SCIENTIFIC NAME
Long-billed marsh wren	Telmatodytes palustris
Mockingbird	Mimus polyglottos
Sage thrasher	Oreoscoptes montanus
American robin	Turdus migratorius
Varied thrush	Ixoreus naevius
Western bluebird	Sialia mexicana
Mountain bluebird	Sialia currucoides
Townsend's solitaire	Myadestes townsendi
Golden-crowned kinglet	Regulus satrapa
Ruby-crowned kinglet	Regulus calendula
Water pipit	Anthus spinoletta
Bohemian waxwing	Bombycilla garrulus
Cedar waxwing	Bombycilla cedrorum
Northern shrike	Lanius excubitor
Loggerhead shrike	Lanius ludovicianus
Starling	Sturnus vulgaris
Warbling vireo	Vireo gilvus
Orange-crowned warbler	Vermivora celata
Yellow warbler	Dendroica petechia
Yellow-rumped warbler	Dendroica curonata auduboni
Audubon warbler	Dendroica auduboni
MacGillivray's warbler	Oporonis tolmiei
Common yellowthroat	Geothlypis trichas
Yellow-breasted chat	Icteria virens
House sparrow	Passer domesticus
Western meadowlark	Sturnella neglecta
Yellow-headed blackbird	Xanthocephalus xanthocephalus
Redwinged blackbird	Agelaius phoeniceus
Northern oriole	Icterus galbula bullockii
Brewer's blackbird	Euphagus cyanocephalus
Brown-headed cowbird	Molothrus ater
Western tanager	Piranga ludoviciana
Black-headed grosbeak	Pheucticus melanocephalus
Blue grosbeak	Guiraca caerulea
Lazuli bunting	Passerina amoena
Evening grosbeak	Hesperiphona vespertina
House finch	Carpodacus mexicanus
Pine siskin	Spinus pinus
American goldfinch	Spinus tristis
Green-tailed towhee	Chlorura chlorura
Rufous-sided towhee	Pipilo erythrophthalmus
Savannah sparrow	Passerculus sandwichensis
Lark sparrow	Chondestes grammacus
Black-throated sparrow	Amphispiza bilineata
Sage sparrow	Amphispiza belli
Dark-eyed junco	Junco hyemalis oreganus
Chipping sparrow	Spizella passerina
Brewer's sparrow	Spizella breweri
White-crowned sparrow	Zontrichia leucophrys
Song sparrow	Melospiza melodia

NOTES: (a) Information supplied by Dr. Ira La Rivers, Biological Society of Nevada, Verdi, Nevada.

Source: (R-21, W-9, I-1, F-11, L-4)

TABLE 3-3

FISH SPECIES KNOWN OR EXPECTED TO OCCUR
IN LOWER TRUCKEE RIVER AND PYRAMID LAKE

FISH SPECIES		INCLUSIVE LOCATION			
COMMON NAME	SCIENTIFIC NAME	VERDI TO RENO	RENO TO DERBY DAM	DERBY DAM TO RIVER MOUTH	PYRAMID LAKE
Lahontan cutthroat trout	Salmo clarki henshawi	x[a]	x	x	x
Rainbow trout	Salmo gairdneri	x	x	x	x
Brook trout	Salvelinus fontinalis	x			
Brown trout	Salmo trutta	x	x	x	
Mountain whitefish	Prosopium williamsoni	x	x	x	
Sacramento perch	Archoplites interruptus		x	x	x
Green sunfish	Lepomis cyanellus	x	x	x	
Bluegill sunfish	Lepomis macrochirus	x	x		
White crappie	Pomoxis annularis		x	x	
Black crappie	Pomoxis nigromaculatus		x	x	
Black bullhead	Ictalurus melas		x	x	
Channel catfish	Ictalurus punctatus		x	x	
Largemouth black bass	Micropterus salmoides	x	x	x	
Cui-ui lakesucker	Chasmistes cujus			o[b]	x
Tui chub	Bicolor gila	o	o	o	x
Tahoe sucker	Catostomus tahoensis	x	x	x	x
Mountain sucker	Catostomus platyrynchus	x	x	x	
Carp	Cyprinus carpio		x	x	x
Lahontan redside	Richardsonius egregius	x	x	x	x
Speckled dace	Rhinichthys osculus	x	x	x	x
Golden shiner	Notemigonus crysoleucas		o	o	
Mosquito fish	Gambusia affinis		o	o	
Piute sculpin	Cottus beldingi	x	x		

NOTES: [a] Known or expected to occur
[b] Present occurrence undetermined

Source: (J-1, R-21, S-20, F-10)

TABLE 3-4

PYRAMID LAKE ALGAE

Chlorophyta

- Dunaliella viridis Teodoresco
- Stichococcus subtilis (Kütz.) Klercker
- Enteromorpha prolifera (Müller) Agardh
- Oedogonium sp.
- Cladophora glomerata (L.) Kützing
- Rhizoclonium hieroglyphicum (Agardh) Kützing
- Botryococcus braunii Kützing
- Spirogyra varians (Hassall) Kützing
- Closterium acerosum (Schrank) Ehrenberg
- Chara sp.

Chrysophyta

- Cyclotella quillensis Bailey
- Chaetoceros muelleri Lemm.
- Synedra pulchella (Ralfs) Kützing
- Navicula gastrum (Ehren.) Kützing
- Caloneis liber (Smith) Cleve
- Anomoeoneis sculpta (Ehren.) Cleve
- Pleurosigma strigilis Smith
- Amphiprora alata (Ehren.) Kützing
- Tropidoneis lepidoptera (Gregory) Cleve
- Gomphonema sp.
- Cymbella mexicana (Ehren.) Cleve
- Surirella nevadensis Hannah & Grant
- Surirella testudo Ehrenberg
- Surirella utahensis Grunow
- Camplyodiscus clypeus (Ehren.) Ehrenberg

Cyanophyta

- Spirulina subsalsa Oersted
- Nodularia spumigena Mertens
- Anabaena inaequalis (Kütz.) Born. & Flah.
- Nostoc sp.
- Calothrix parietina (Nägeli) Thuret
- Porphyrosiphon notarisii (Meneghini) Kützing (formerly reported as Oscillatoria terebriformis and O. chalybea)
- Microcoleus lyngbyaceus (Kütz.) Crouan (formerly reported as O. simplicissima)
- Arthrospira brevis (Kütz.) Drouet (formerly reported as O. brevis)
- Schizothrix calcicola (Agardh) Gomont (formerly reported as Phormidium tenue, P. treleasi, P. valderianum)

Source: (K-5)

TABLE 3-5

THE STATION 4 (McCARRAN) BENTHOS ASSOCIATION IN ORDER OF AVERAGE ABUNDANCE PER SQUARE FOOT FROM LATE SUMMER TO WINTER CONDITIONS

Higher Taxonomic Groups	Lower Taxonomic Groups	Buoy 1967 Aug.-Dec.[b]		Buoy 1967 Aug.-Nov.[c]		Myers 1966[d] Aug.-Nov.[e]
Trichoptera	Hydropsyche sp.	71.74	1[a]	64.16	2[a]	74.17
Diptera	Tendipedidae	57.18	2	28.41	3	13.64
Ephemeroptera	Baetinae	3.08	3	2.37	4	3.25
Trichoptera	Hydropsyche--live caddis fly cases	2.00		2.26		---[f]
Nematoda	Nematoda	1.73	4	1.32		
Trichoptera	Hydroptila sp.	1.10	5	1.24		
Oligochaeta	Tubificidae	.90		.94	1	p[g]
Lepidoptera	Parargyractis sp.	.61		.55		.25
Ephemeroptera	Ephemerella sp. #2	.61		.55		
Diptera	Tipulidae	.59		.61		
Trichoptera	Cheumatopsyche sp.	.46		.36		
Plecoptera	Arcynopteryx sp.	.42		.41		
Ephemeroptera	Tricorythodes sp.	.24		.28		
Ephemeroptera	Heptagenia sp.	.17		.19		
Turbellaria	Dugesia sp.	.15		.17		.44
Diptera	Antocha sp.	.10		.11		
Plecoptera	Isoperla sp.	.07		.03		
Oligochaeta	Lumbricidae	.07		.06		.03
Hydracarina	Hydracarina	.05		.06		
Coleoptera	Elmidae	.05		.06		
Ephemeroptera	Ephemerella sp. #1	.02		.03		
Plecoptera	Alloperla sp.	.02		.03		
Trichoptera	Glossosoma sp.	.02		.03		
Hirudinea	Arhynchobdellida	---[f]		---[f]	5	1.29
Crustacea	Gammaridae	---[f]		---[f]		.22
Gastropoda	Ancylidae	---[f]		---[f]		.17
Diptera	Psychodidae	---[f]		---[f]		.14
Top Five Organisms		26.97		19.50		22.88

NOTES:
(a) Numbers indicate the top five organisms for the 1966 and 1967 sample dates.
(b) August 6 through December 12, 1967 = 9 samples.
(c) August 6 through November 18, 1967 = 8 samples.
(d) August 7 through November 20, 1966 = 8 samples.
(e) As found by L. H. Myers (1967) before the installation of the co-operating water treatment system between Reno and Sparks.
(f) No acknowledgment in group listings.
(g) P = Present

Source: (B-17)

TABLE 3-6

THE STATION 1 (MAYBERRY) BENTHOS ASSOCIATION IN ORDER OF AVERAGE ABUNDANCE PER SQUARE FOOT FROM LATE SUMMER TO WINTER CONDITIONS

Higher Taxonomic Groups	Lower Taxonomic Groups	Buoy 1967 Aug.-Dec.[b]		Buoy 1967 Aug.-Nov.[c]		Myers 1966[d] Aug.-Nov.[e]
Diptera	Tendipedidae	11.66	1[a]	11.14		4.73
Ephemeroptera	Baetinae	7.04	2	6.71	2[a]	17.13
Trichoptera	Hydropsyche sp.	4.77	3	4.79	4	8.47
Trichoptera	Hydroptila sp.	3.72	4	3.05	1	44.25
Trichoptera	Cheumatopsyche sp.	3.67	5	3.80	3	13.48
Ephemeroptera	Ephemerella sp. #2	2.98		1.43		.09
Ephemeroptera	Heptagenia sp.	1.52		1.65		2.09
Ephemeroptera	Ephemerella sp. #1	1.27		1.27		.30
Diptera	Tipulidae	1.17		1.18		0.00
Oligochaeta	Tubificidae	.81		.80		0.00
Diptera	Antocha sp.	.78		.55		1.35
Plecoptera	Arcynopteryx sp.	.76		.83		0.00
Ephemeroptera	Paraleptophlebia sp. #2	.66		.74		0.00
Oligochaeta	Lumbricidae	.61		.66		0.00
Plecoptera	Alloperla sp.	.39		.14		0.00
Crustacea	Gammaridae	.39		.44		0.00
Plecoptera	Isogenus sp.	.29		.25		2.00
Trichoptera	Hydropsychidae--live caddisfly cases	.20		.22		---[f]
Hydracarina	Hydracarina	.20		.17		.39
Trichoptera	Glossosoma sp.	.17		.17	5	6.63
Coleoptera	Elmidae	.17		.06		.61
Coleoptera	Simuliidae	.12		.14		---[f]
Lepidoptera	Parargyractis sp.	.10		.03		3.14
Nematoda	Nematoda	.10		.11		.03
Plecoptera	Isoperla sp.	.10		.08		.85
Trichoptera	Agapetus sp.	.10		.11		3.48
Gastropoda	Ancylidae	.10		.08		.03
Crustacea	Pacifastacus sp.	.10		.11		.06
Turbellaria	Dugesia sp.	.10		.11		.03
Ephemeroptera	Paraleptophlebia helena	.10		.08		---[f]
Plecoptera	Perlidae	.05		.06		---[f]
Trichoptera	Rhyacophilia sp.	.05		.06		.08
Trichoptera	Hasperophylax sp.	.05		.06		---[f]
Trichoptera	Phyrganeidae	.02		.03		---[f]
Plecoptera	Paraperla sp.	.02		.03		---[f]
Diptera	Phoridae	.02		.03		---[f]
Coleoptera	Histeridae	.02		.03		---[f]
Coleoptera	Eurystethidae	.02		.03		---[f]
Top Five Organisms		6.17		5.90		17.92

NOTES: (a) Numbers indicate the top five organisms for the 1966 and 1967 sample dates.

(b) August 6 through December 12, 1967 = 9 samples.

(c) August 6 through November 17, 1967 = 8 samples.

(d) August 7 through November 20, 1966 = 8 samples.

(e) As found by L. H. Myers 1967 before the installation of the co-operating water treatment system between Reno and Sparks.

(f) No acknowledgment in the group listings by Myers.

Source: (B-17)

TABLE 3-7

INVERTEBRATE BIOTA OF PYRAMID LAKE

- ARTHROPODA (Joint-legged animals)
  - INSECTA (Insects)
    - DIPTERA (Flies)
      - Tendipedidae (Midges)
        - *Hydrobaenus* sp. (Smittia)
      - Ephydriadae (Shore flies)
        - *Gymnopa bidentata*
        - *Lamproscatella nirosa*
        - *Parydra tibialis*
        - *Parydra nitida*
        - *Parydra halteralis*
        - *Paracoenia bisetosa*
    - COLEOPTERA (Beetles)
      - Dytiscidae (Predaceous water beetles)
        - *Hygrotus fastidiosus* (Bruce 1932, La Rivers 1951)
      - Hydrophilidae (Herbivorous water beetles)
        - *Leccobius ellipticus* (Bruce 1932, La Rivers 1954)
        - *Enochrus carinatus* (some)
        - *Tropisternus laterallis*
      - Dryopidae (Crawling water beetles)
        - *Microcyllocpus similis* (La Rivers 1950)
      - Heteroceridae (Mud beetles)
        - *Heterocerus gemmatus*
    - TRICHOPTERA (Caseflies)
      - Psychomyiidae
        - *Polycentropus halidus*
    - HEMPITERA (Bugs)
      - Naucoridae (Crawling water bugs)
        - *Ambrysus mormon* (La Rivers 1951)
    - ODONATA (Dragonflies - Damselflies)
      - Gomphidae (Clubtails)
        - *Ophiogomphus morrisoni* (La Rivers 1940, 1946)
      - Libellulidae (Skimmers)
        - *Sympetrum corruptum* (La Rivers 1940, 1946)
      - Coenagriidae (Damsel flies)
        - *Enallagma clausum* (La Rivers 1940, 1946)
  - CRUSTACEA (Crustaceans)
    - DECAPODA (Crawfish, Crabs, etc.)
      - Astacadiae (Western crawfish)
        - *Pacifastacus lenivsculus*
    - AMPHIPODA (Scuds)
      - Gammaridae (Freshwater shrimps)
        - *Gammarus* sp.
- ANNELIDA (Segmented worms)
  - OLIGOCHAETA (Earthworms)
  - HIRUDINEA (Leeches)
- NEMATODA (Roundworms)
- PLATYHELMINTHES PLANARIA (Flatworms)
  - TURBELLARIA

Source: (I-1)

APPENDIX 4
AIR QUALITY ANALYSIS

TABLE 4-1

AIR POLLUTANT SOURCE EMISSIONS INVENTORY

SOURCE	ALDEHYDES	BENZO-PYRENE[a]	CARBON MONOXIDE	HYDROCARBONS	OXIDES OF NITROGEN	OXIDES OF SULFUR	AMMONIA	ORGANIC ACIDS	PARTI-CULATES	DUST
Natural Gas - Residential			49,220	19,688	196,880	4,101			24,611	
Natural Gas - Commercial			56,967	10,053	402,120	2,010			33,510	
Natural Gas - Industrial										
Furnace Oil	37,650		94,125	56,475	225,900	2,673,150			188,250	
Residual Oil	3,472		13,888	10,416	138,880	545,104			79,856	
Coal	5		100,350	22,300	3,345	42,370			22,300	
Liquid Petroleum Gas			3,739	748	27,918	22,434			4,237	
Open Burning (Est)	350,400		7,455,360	24,532,320	52,596	105,120			4,129,648	
Approved Incinerators	1,060		1,800	1,060	7,050	6,500			15,000	
Residential Fireplaces	NA[f]	NA	NA	NA	NA	NA	NA		490,000	
Solvents-Dry Cleaning				320,200						
Gasoline-Storage & Handling				7,252,798						
Gasoline-Motor Vehicle	346,200	57	251,862,929	45,352,637	9,780,244	778,957	173,101	346,203	952,059	
Diesel-Truck, Bus, Train	55,611		4,170,825	605,869	6,858,690	500,499		55,611	240,981	
Fuel-Aircraft			3,361,228	617,360	242,923	35,394			24,046	
Sand & Gravel Pits (Estimate)										9,000,000
Asphalt Plants	3,500		3,500	3,500	135,000	2,600	3,400	8,000	24,000	386,000
Concrete Batching Plants									110,000	11,680
U.S. Gypsum Plant (Est)[b]									22,094	
Tracy Power Station[c]	1,947		16,915	10,405	808,920	309,683			823,333	
Eagle Pitcher Plant[d]			1,399,678	247,002	14,408,450	49,400			365,000	
Diatomaceous Earth Proc[e]										
Auto Painting				7,500						
Kerosene Handling & Storage				200,368						
Est. Fuel Handling & Storage				64,337						
Total in Pounds	799,840	57	268,590,524	79,335,036	33,288,916	5,077,322	176,501	3,525,644	7,548,925	9,397,680
Total in Tons	400	---- (g)	134,295	39,535	16,644	2,539	88		3,774	4,699

NOTES: (a) Reported in grams

(b) Located Empire, Nevada (Washoe County)

(c) Located Clark Station (Storey County) X1/3

(d) Located Clark Station (Storey County) X1/3

(e) Located 1/8 mile outside of Jurisdiction 1/3

(f) N.A. Not Available

(g) ---- Not Contributing

Total Pounds 407,740,445 Total Tons 203,736

Source: (H-11)

Preceding page blank

APPENDIX 5

TRUCKEE MEADOWS WATER BUDGET

Preceding page blank

APPENDIX 5

TRUCKEE MEADOWS WATER BUDGET

The water budget for the Truckee Meadows Subbasin consists of inflows and outflows of water through all hydrologic processes. The subbasin has a capacity for storing water in surface-water reservoirs and streams, and in groundwater aquifers. There is a balance at all times between inflows to the subbasin, changes in water storage within the subbasin, and outflows from the subbasin. If inflows into Truckee Meadows exceed outflows, then water storage increases to absorb the excess. Conversely, if outflows exceed inflows, storage decreases.

The inflow components of the water budget include surface water and groundwater flows, precipitation, and imported water from surrounding basins. Outflow components include surface and groundwater flows, exported water, evaporation, and transpiration. The water users which consume water in the Truckee Meadows area contribute to the outflow components of the water budget primarily through evaporation and transpiration.

Inflows and outflows can be estimated from historic stream flow records, precipitation and weather data, and records on imported and exported water. The storage of water within Truckee Meadows is much more difficult to measure, primarily because of uncertanties pertaining to groundwater storage and groundwater interaction with surface water bodies. While the volume of water in storage decreases or increases during dry or wet years, respectively, over long-term periods the amount of water in storage averages to some constant level, implying that inflows to Truckee Meadows are essentially equal to outflows over a long period of time.

The secondary hydrologic impacts of wastewater treatment plant expansion (namely, increased urban water consumption) can best be quantified by analyzing the future Truckee Meadows water budget, especially in comparison to the present water budget.

Preceding page blank

PRESENT TRUCKEE MEADOWS WATER BUDGET

The present water budget for Truckee Meadows was determined by using the 1975 population, water use records, and long-term averages of stream flows in the Truckee River and its tributaries. For the purposes of analyzing future water budgets, long-term average inflows and outflows are more significant than the single-year flow records for 1975 or any previous year. At some stations, records on Truckee River flow date back to 1900, and the 50-year period (1919-1969) has been utilized for prior long-term water budget studies in the Truckee Basin (V-1). If the 1975 population and water consumption patterns in Truckee Meadows remain constant in the future, then the expected water budgets in the future will correspond to the 1975 water budget if long-term inflow and outflow averages are used.

The 1975 water budget of the Truckee Meadows Subbasin is presented in Table 5-1. Surface water inflows to the Meadows have averaged 530,000 acre-ft/yr from the Truckee River and 17,000 acre-ft/yr from Steamboat Creek and the North Truckee Drain (V-1). The Meadows receives an estimated 1,100 acre-ft/yr in groundwater inflow through the alluvium from the Truckee Canyon segment, Pleasant Valley, Sun Valley, and Spanish Springs Valley (V-1). Precipitation in the form of snow and rain contributes an average of 160,000 acre-ft/yr, but only about 30,000 acre-ft/yr (V-1) of this total is available as potential recharge to groundwater storage and surface water runoff. The remainder (about 130,000 acre-ft/yr) returns to the atmosphere through evaporation. Therefore, the total inflow to Truckee Meadows is approximately 580,000 acre-ft/yr, based upon averages for the period 1919-1969.

The greatest outflows from the Truckee Meadows Subbasin occur via the Truckee River at Vista (480,000 acre-ft/yr) (V-1). Another 17,000 acre-ft/yr is exported to Lemmon Valley and Spanish Springs Valley (V-1). Outflows from groundwater storage are effectively prevented by the mountains surrounding the Meadows, and are considered to be minor (V-1). These outflow components total approximately 500,000 acre-ft/yr.

To arrive at a balance between inflow and outflow, another 80,000 acre-ft/yr in outflows must be accounted for. Much of this amount can be attributed to four major consumption components within Truckee Meadows: 1) evaporation and transpiration from irrigated lands; 2) transpiration from

TABLE 5-1

1975 TRUCKEE MEADOWS ESTIMATED WATER BUDGET

Inflows to Truckee Meadows		Amount (acre-ft/yr)
Surface water and imports		547,000
Groundwater		1,000
Precipitation		30,000
TOTAL (rounded)		580,000
Outflows from Truckee Meadows		
Surface water		480,000
Exports		17,000
Groundwater		Minor
Consumption		80,000
Irrigation	38,000	
Phreatophytes	7,000	
Urban	17,000	
Miscellaneous	18,000	
Subtotal	80,000	
TOTAL (rounded)		580,000

phreatophytes; 3) evaporation arising from domestic, municipal, and industrial consumption; and 4) miscellaneous consumption which cannot be accounted for under normal practices.

Irrigated land areas in Washoe County occupied approximately 32,700 acres in 1970 (A-1). A separate study (V-1) presented a more detailed inventory of irrigated lands and reported a total of 26,000 acres for the Truckee River Basin as a whole, with about 22,900 acres lying in Washoe County. This inventory reported 18,000 acres being irrigated in the Truckee Meadows Subbasin in 1970 (V-1).

Average water consumption on irrigated lands in the Truckee River Basin is 2.1 acre-feet per irrigated acre per year (S-7). While there is no record of irrigated land areas for the year 1975, an estimate of 18,000 acres can be used as an upper limit. Using this acreage and the average water consumption rate, irrigated lands in Truckee Meadows consume about 38,000 acre-ft/yr.

Semi-irrigated pastures and meadows in Washoe County occupied 10,300 acres in 1970 (A-1). Much of this land (about 7,000 acres [V-1] of the Truckee Meadows Subbasin) is covered with phreatophytic vegetation (A-1). Transpiration rates from phreatophytes vary according to vegetation density, depth to water, and type of plant (A-1). Assuming a phreatophytic water consumption rate of 1.0 acre-ft/acre/yr, (not unreasonable for the Truckee Meadows Subbasin [A-1]), approximately 7,000 acre-ft/yr is consumed by phreatophytes in Truckee Meadows.

Domestic, municipal, and industrial water consumption within Truckee Meadows is almost entirely accounted for by water supplied by the Sierra Pacific Power Company. In 1975, this power company supplied 13.454 billion gallons of water to the cities of Reno and Sparks (S-26) for an average flow of 36.9 MGD (equivalent to about 41,200 acre-ft/yr). Flow through the Reno/Sparks JWPCP during 1975 averaged 21.6 MGD (24,100 acre-ft/yr). The difference of 17,100 acre-feet can be accounted for by water-intensive activities (such as lawn watering) which do not return water to the sewer collection system. Although it was recognized that some of the 17,100 acre-feet was lost through evaporation and transpiration to the atmosphere and a small portion entered ground and surface water systems, these losses were assumed to be slight. Therefore, a conservative estimate would be that all 17,100 acre-feet was consumed by urban activities. Based upon the 1975 estimated population

for Reno and Sparks (123,326), this consumption rate is equivalent to 124 gallons per capita per day (gpcd).

To account for the entire 80,000 acre-ft/yr consumed within Truckee Meadows, the loss of another 18,000 acre-ft/yr must be explained. This remainder can be attributed to miscellaneous consumption and errors in approximating the other components of the water budget. Those additional consumers in Truckee Meadows who withdraw water from wells and the Truckee River account for unknown and unmeasurable consumption. Moreover, since phreatophytic water consumption rates can vary substantially from place to place and year to year, these rates can only be roughly estimated. Therefore, the remaining 18,000 acre-ft/yr can be assumed to be lost to miscellaneous sources and, for projection purposes, this loss can be assumed to remain constant over time.

YEAR 2000 TRUCKEE MEADOWS WATER BUDGET

The projected water budget for the Truckee Meadows area is based upon one fundamental assumption: that past meteorological patterns will continue. If rainfall, temperature, wind, and evaporation patterns have remained relatively the same since 1900, then streamflow records between 1900 and 1975 will indicate expected quantities of surface water available in the future.

The comparison of 1975 and year 2000 water budgets is best accomplished by assuming that hydrologic inputs to Truckee Meadows will be the same in the year 2000 as they were prior to 1975. This assumption is valid only if no further development occurs upstream from Reno around Lake Tahoe and in the Truckee River Valley. While, in reality, this assumption is incorrect, it enables us to focus only upon changes within the Meadows. Certainly future development is likely to occur around Lake Tahoe, and future water consumption will rise correspondingly. Any water subtracted from flows into Truckee Meadows will also be taken from Truckee Meadows outflows.

The projected year 2000 water budget for Truckee Meadows is presented in Table 5-2. Inflows to the Truckee Meadows Subbasin are assumed to be 580,000 acre-ft/yr on the average. Since outflows are dependent upon changes in water consumption within Truckee Meadows, this component should be estimated first.

TABLE 5-2

2000 TRUCKEE MEADOWS WATER BUDGET

Inflows to Truckee Meadows		Amount (acre-ft/yr)
Surface water and imports		547,000
Groundwater		1,000
Precipitation		30,000
TOTAL (rounded)		580,000
Outflows from Truckee Meadows		
Surface water		486,000
Exports		17,000
Groundwater		Minor
Consumption		74,000
Irrigation	16,000	
Phreatophytes	3,000	
Urban	37,000	
Miscellaneous	18,000	
Subtotal	74,000	
TOTAL (rounded)		580,000

The four categories of water consumption in 1975 will still be present in the year 2000. Since irrigated and phreatophytic lands will likely decrease in acreage, being replaced by urban land uses, water consumption by irrigated and phreatophytic lands will decrease and urban water consumption will increase. Consumption by miscellaneous sources will be assumed to remain constant from 1975 to 2000.

Based upon a 1970 total of 32,740 acres (A-1), agricultural land projections indicate that there will be 12,350 acres of irrigated land in Washoe County in 1990, and 3,700 acres in the year 2020 (A-1). These projections indicate that agricultural lands will decrease at the rate of 288 acres per year after 1990 and by the year 2000, Washoe County will have about 9,500 acres of agricultural land.

Truckee Meadows is a separate hydrologic subbasin within Washoe County. Van Denburgh et al. (O-4) reported that out of a total of 22,900 acres of irrigated lands in Washoe County in 1970, 18,000 acres of this total were located in Truckee Meadows. Thus, irrigated lands in Truckee Meadows contribute 79 percent of the total irrigated area in Washoe County.

Using these statistics, Truckee Meadows will have 79 percent of the 9,500 acres of agricultural lands in Washoe County (or 7,500 acres). At the rate of 2.1 acre-ft-acre/yr, irrigated lands will consume about 16,000 acre-feet in the year 2000.

In 1970 irrigated lands occupied 22,900 acres in Washoe County (O-4). By the year 2000, irrigated lands are projected to occupy only 9,500 acres, a decrease of 41 percent. Assuming the same pattern applies to phreatophytic lands within Truckee Meadows, by the year 2000 this type of land will occupy 3,000 acres. At a consumption rate of 1.0 acre-ft/acre/yr, these lands will consume 3,000 acre-feet of water in the year 2000.

Assuming that phreatophytic acreages decrease in the same proportion as irrigated lands, then about 3,000 acres will remain in the year 2000. At a consumption rate of 1.0 acre-ft/acre/yr, phreatophytic lands will consume about 3,000 acre-feet.

Presumably urban water consumption will increase in proportion to population. The 1975 consumption rate in Reno and Sparks averaged 124 gpcd (not including the tourist population). Plant expansion was designed to

handle a year 2000 population of 267,000 people (not including an additional 10 percent of the population for tourism). Using a permanent population level of 267,000 for the year 2000 and assuming no increases in consumption rates, then about 37,000 acre-feet will be consumed by urban uses (conversion is based upon 1.0 MGD equals 1116.9 acre-ft/yr).

Total consumption in Truckee Meadows for the year 2000 is equal to the sum of irrigation (16,000 acre-ft), phreatophytes (3,000 acre-ft) urban water consumption (37,000 acre-ft), and miscellaneous uses (18,000 acre-ft/yr) which is comparable to the 1975 consumption rate of 80,000 acre-ft/yr. The decrease of 6,000 acre-ft/yr consumption would increase surface water outflows to the Truckee River by the same amount thereby maintaining the inflow-outflow balance.

The increase in Truckee River flows from 480,000 acre-ft/yr in 1975 to 486,000 acre-ft/yr in 2000 is an increase of slightly more than 1 percent. In light of the estimates used, this 1 percent increase is not significant.

APPENDIX 6
TRUCKEE RIVER FLOW GAUGE DATA

TABLE 6-1

ANNUAL FLOWS OF TRUCKEE RIVER, WATER YEARS 1900-69
IN THOUSANDS OF ACRE-FEET

Water Year	At Farad (3460)	At Reno (3480)	Truckee R. at Derby Dam	Truckee Canal Diversion	Pyramid Lake Inflow
1900	444				
1901	677				
1902	545				
1903	520				
1904	1,130				
1905	638				
1906	984				
1907	1,430	1,370			
1908	681	522			
1909	1,010	933			
1910	790	712			
1911	1,110	1,020			
1912	438	285			
1913	429	286			
1914	846	818			
1915	593	455			
1916	807	699			
1917	708	595			
1918	491	348	452.8	203.0	
1919	583	456	514.0	234.3	
1920	410	288	330.1	245.0	
1921	503	416	433.3	229.6	
1922	631		625.0	223.9	
1923	521		557.1	259.1	
1924	270		215.9	161.3	
1925	355		341.5	246.8	
1926	276	194	248.0	195.1	
1927	614		616.2	278.7	
1928	509		496.3	205.1	
1929	262		209.7	189.7	26.4
1930	345		293.9	255.9	40.7
1931	133	77	103.2	98.8	8.2
1932	390	338	340.8	230.7	115.1
1933	207	125	151.2	127.9	32.8
1934	207	121	136.7	123.9	20.6
1935	373		320.3	197.2	126.2
1936	489		416.2	248.9	181.6
1937	413		353.7	183.6	190.4
1938	844		865.5	142.9	737.3
1939	352		300.8	160.7	149.8
1940	572		549.3	278.2	280.4
1941	482		435.5	254.0	194.8
1942	750		725.2	175.3	550.8
1943	849		895.9	193.3	702.3
1944	384		338.4	258.3	87.8
1945	452		417.7	282.7	145.4
1946	506		459.9	254.5	212.7
1947	366	249	294.8	243.4	80.8
1948	390	271	317.8	297.5	31.6
1949	353	238	291.2	281.2	15.5

Preceding page blank

TABLE 6-1

ANNUAL FLOWS OF TRUCKEE RIVER, WATER YEARS 1900-69
IN THOUSANDS OF ACRE-FEET
(continued)

Water Year	At Farad (3460)	At Reno (3480)	Truckee R. at Derby Dam	Truckee Canal Diversion	Pyramid Lake Inflow
1950	480	373	444.1	353.5	96.4
1951	784	709	810.7	282.7	544.6
1952	1,280	1,230	1,307.5	368.8	1,034.5
1953	643	544	658.2	361.2	278.0
1954	417	284	374.1	328.0	48.2
1955	364	224	302.2	293.0	15.1
1956	861	784	828.9	313.3	515.6
1957	521	404	474.5	375.8	88.7
1958	887	794	796.9	369.8	520.8
1959	370	232	305.0	290.5	24.5
1960	379	231	312.8	298.2	25.3
1961	249	133	211.4	203.9	18.2
1962	345	237	293.4	258.3	47.0
1963	578	507	591.6	305.1	319.9
1964	382	269	299.8	281.4	42.0
1965	700	614	684.3	271.3	436.9
1966	485	355	398.0	268.7	153.3
1967	892	830	937.8	333.8	640.0
1968	443	333	432.5	181.2	240.9
1969	1,120	1,080	1,197.0	170.7	973.7
Average for period of full-year record	575	488	474.6	253.7	244.0

Source: (V-1, P-2)

APPENDIX 7

RENO/SPARKS WASTEWATER TREATMENT PLANT DISCHARGE DATA

TABLE 7-1

RENO/SPARKS WASTEWATER TREATMENT PLANT DISCHARGE DATA

	Month/Year											
	12/74	1/75	2/75	3/75	4/75	5/75	6/75	7/75	8/75	9/75	10/75	11/75
Flow Summary (mgd)												
Maximum Daily Flow	19.22	19.70	21.45	21.79	19.97	19.78	20.07	20.31	28.63	26.78	19.23	22.61
Average Daily Flow	16.81	17.84	17.93	17.70	17.71	17.83	18.85	19.02	19.59	20.05	18.63	17.79
Reno Ave. Daily Flow	13.37	13.99	13.93	13.88	13.46	13.63	14.37	14.45	14.94	15.58	14.49	13.90
Sparks Ave. Daily Flow	3.44	3.85	4.00	3.82	4.07	4.20	4.48	4.57	4.65	4.47	4.14	3.89
Chlorination												
Total Used (lbs)	18,640	23,352	20,549	[illegible],768	21,133	21,561	19,374	23,649	25,624	22,994	25,765	21,076
Ave. 30" CL_2 Residual (mg/l)	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.1	1.2	1.1	1.1	1.2
Min. 30" CL_2 Residual (mg/l)	0.8	0.5	0.9	1.0	1.1	1.1	1.1	1.0	1.1	1.0	1.1	1.0
Methane Gas Prod.												
Total (cu. ft.)	9.8M	10.1M	9.3M	10.3M	10.1M	9.5M	8.2M	8.5M	9.4M	8.5M	9.0M	8.8M
Ave. Daily (cu. ft.)	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M	0.3M
Suspended Solids												
Influent Ave. (mg/l)	281	270	196	233	262	277	248	253	250	298	343	365
Effluent Ave. (mg/l)	12	23	17	16	16	14	13	12	11	13	13	14
Removal, Ave. (%)	96	92	91	93	94	95	95	95	96	96	96	96
Settleable Solids												
Influent Ave. (mg/l)	23	15	8	10	292	15	10	12	11	13	21	25
Effluent Ave. (mg/l)	T	T	T	T	T	T	T	T	T	T	T	T
Removal Ave. (%)	99	99	99	99	99	99	99	99	99	99	99	99
5-Day BOD												
Influent Ave (mg/l)	288	262	187	187	232	203	191	125	176	194	214	239
Effluent Ave. (mg/l)	8	6	7	6	11	10	9	9	9	9	11	8
Removal Ave. (%)	97	98	96	97	95	95	95	93	95	95	95	97
Grease												
Influent Ave. (mg/l)	50.1	79.4	80.5	69.4	50.2	47.3	53.5	38.2	91.6	44.8	33.6	76.1
Effluent Ave. (mg/l)	9.5	16.1	10.2	11.8	0.7	8.3	3.2	8.0	8.2	0.7	6.7	16.2
Removal (%)	81	80	87	83	99	82	91	79	92	99	80	79
Detergents												
Influent Ave. (mg/l)	2.9	3.5	3.2	4.2	6.4	2.8	2.9	3.1	3.8	2.2	3.4	3.6
Effluent Ave. (mg/l)	0.4	0.4	0.2	2.0	0.8	0.3	0.1	0.3	0.3	0.2	0.2	0.3
Removal Ave. (%)	86	89	94	52	88	89	97	90	92	90	94	92
Effluent Dissolved O_2												
Average (mg/l)	7.5	8.0	8.5	8.4	9.2	8.7	7.3	8.0	8.0	7.9	8.0	8.6
Minimum (mg/l)	5.8	7.0	7.0	7.4	8.2	7.8	6.0	7.0	7.2	7.5	7.6	7.1

Source: (R-3)

Preceding page blank

APPENDIX 8

WATER QUALITY MODEL

Preceding page blank

APPENDIX 8

WATER QUALITY MODEL

Water quality models play an important role in predicting the environmental impacts of alternative courses of action. A well calibrated and verified model can be used (as was done in this case) to predict the water quality in a stream resulting from implementation of alternative wastewater management discharge systems.

A wide variety of water quality models are currently available. These models range from extremely simplistic mass balances to very complex ecological models that depict several trophic levels. Models have been used to depict steady-state conditions as well as complex dynamic variations. Models can be one-dimensional, two-dimensional, or even three-dimensional. Unfortunately, as the degree of model sophistication and complexity increases, the data requirements increase rapidly. Trade-offs must be made between data availability and the level of information desired from a modeling study.

In developing a model to predict water quality for the Truckee River, it was decided to utilize a relatively simplistic model structure in light of the limited data available. A one-dimensional, steady-state model was employed due to a lack of cross-sectional and diel water quality data. Data on the North Truckee Drain and Steamboat Creek was incomplete. Data on the various forms of nitrogen and phosphorus in the effluent from the JWPCP and in the Truckee River itself was also incomplete. These data limitations necessitated use of a relatively simplistic model. The model developed is described in the following paragraphs.

A mass balance was performed to estimate the concentrations immediately downstream from Steamboat Creek and the outfall from the Reno/Sparks JWPCP. The equation utilized for each parameter investigated was:

$$C_{DS} = \frac{C_R \cdot Q_R + C_{JWPCP} \cdot Q_{JWPCP} + C_S \cdot Q_S + C_{TD} \cdot Q_{TD}}{Q_R + Q_{JWPCP} + Q_S + Q_{TD}}$$

Preceding page blank

where: C_{DS} = concentration in the river downstream of Steamboat Creek

C_R = concentration in the Truckee River above Steamboat Creek

C_{JWPCP} = concentration in the effluent for the JWPCP

C_S = concentration in Steamboat Creek

C_{TD} = concentration in the North Truckee Drain

Q_R = flow in the Truckee River above Steamboat Creek (cfs)

Q_{JWPCP} = flow from the JWPCP (cfs)

Q_S = flow in Steamboat Creek (cfs)

Q_{TD} = flow in the North Truckee Drain (cfs)

The interrelationships between BOD, dissolved oxygen, and stream temperature were modeled using the Streeter-Phelps approach (S-27, P-7). This approach assumes that both BOD exertion and atmospheric reaeration can be described by first-order kinetics. The Streeter-Phelps equation can be written as follows:

$$D_t = \frac{K_1 L_a}{K_2 - K_1} (10^{-K_1 t} - 10^{-K_2 t}) + D_a 10^{-K_2 t}$$

where: D_t = dissolved oxygen deficit in the stream at time t ($D_t = C_s - C_t$) (mg/l)

C_s = saturation concentration of dissolved oxygen at the stream temperature (mg/l)

C_t = concentration of dissolved oxygen at time t (mg/l)

K_1 = coefficient of deoxygenation ($time^{-1}$)

K_2 = reaction coefficient for atmospheric reaeration ($time^{-1}$)

L_a = ultimate first-stage BOD at time t = 0 and at stream temperature (mg/l)

D_a = initial dissolved oxygen deficit at time t = 0

C_o = concentration of dissolved oxygen at time t = 0 at start of the reach (mg/l)

t = time of travel from the start of the reach

This approach was used to estimate BOD and dissolved oxygen levels from Steamboat Creek to Derby Dam.

Nitrification was not modeled since it was found that first-order BOD exertion gave acceptable results for the dissolved oxygen profile from Steamboat Creek to Derby Dam. In addition, data regarding the various forms of nitrogen was lacking. Nitrification may play a significant role downstream from Derby Dam once a viable population of nitrifying organisms becomes established. Benthal demands were not included since the bottom of the Truckee River is mainly sand and gravel below Steamboat Creek with few sludge beds and, hence, low benthal contributions. The river was not modeled below Derby Dam since the forces affecting water quality in these reaches are not significantly affected by the discharge from the JWPCP.

APPENDIX 9

NOISE LEVEL CALCULATIONS

Preceding page blank

TABLE 9-1

NOISE LEVEL CALCULATIONS

(1) 1,000 Vechicles
50 Trucks @ 85
950 Autos @ 77

(2) 5,000 Vechicles
250 Trucks @ 85
4,750 Autos @ 77

(3) 10,000 Vechicles
500 Trucks @ 85
9,500 Autos @ 77

(4) 20,000 Vechicles
1,000 Trucks @ 85
19,000 Autos @ 77

(5) 30,000 Vechicles
1,500 Trucks @ 85
28,500 Autos @ 77

TRUCKS

	N_F	=	$(ADT).5_{day} + 10(ADT).5_{night}$
(1)	275	=	(50).5 + 10(50).5
(2)	1,375	=	(250).5 + 10(250).5
(3)	2,750	=	(500).5 + 10(500).5
(4)	5,500	=	(1000).5 + 10(1000).5
(5)	8,250	=	(1500).5 + 10(1500).5

AUTOS

	N_F	=	$(ADT).5_{day} + 10(ADT).5_{night}$
(1)	5,225	=	(950).5 + 10(950).5
(2)	26,125	=	(4750).5 + 10(4750).5
(3)	52,250	=	(9500).5 + 10(9500).5
(4)	104,500	=	(19000).5 + 10(19000).5
(5)	156,750	=	(28500).5 + 10(28500).5

Preceding page blank

BIBLIOGRAPHY

A-1 Agriculture, Department of. Water and Related Resources, Central Lahontan Basin, Nevada River Basin Study Staff, July 1975.

A-2 Air Pollution Control Administration. Reno Metropolitan Area Air Pollutant Emission Inventory, McGraw, M. J., NTIS PB-207-697, August 1970.

A-3 Amtrak Public Relations Office. Personal Communication, San Francisco, February 1976.

A-4 Aero Vironment, Inc. Truckee Meadows Basin Air Quality Study, Vol. I, prepared for State of Nevada, Department of Highways and Federal Highway Administration, Nevada Division, Pasadena, CA, April 1976.

A-5 Aero Vironment, Inc. Truckee Meadows Basin Air Quality Study, Vol. II, prepared for State of Nevada, Department of Highways and Federal Highway Administration, Nevada Division, Pasadena, CA, April 1976.

B-1 Blue Ribbon Task Force Program. Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #1, April 1974.

B-2 Blue Ribbon Task Force Program. "Air Pollution", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #2, February 1974.

B-3 Blue Ribbon Task Force Program. "Housing", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #3, December 1973.

B-4 Blue Ribbon Task Force Program. "Codes", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #4, January 1974.

B-5 Blue Ribbon Task Force Program. "Design", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #5, December 1973.

B-6 Blue Ribbon Task Force Program. "Physical Constraints", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #6, December 1973.

B-7 Blue Ribbon Task Force Program. "Economics of Growth", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #7, December 1973, January 1974.

B-8 Blue Ribbon Task Force Program. "Public Finance", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #8, December 1973.

B-9 Blue Ribbon Task Force Program. "Optimum Size", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, #9, February 1974.

B-10 Blue Ribbon Task Force Program. "Plan Relationships", Growth and Development Reports, Reno, Sparks and Washoe Nevada, #10, December 1973.

B-11 Brown, J. W. "History of Reno/Sparks Area; Reno: The West's Biggest Little City", Nevada Historical Society, Sound/Slide Series Number Fifteen.

B-12 Blue Ribbon Task Force. "Summary of Findings and Recommendations", Growth and Development Reports, Reno, Sparks and Washoe County, Nevada, October 1973.

B-13 Bureau of Business and Economic Research. Nevada Business Review, Reno: University of Nevada, March 1965, October 1968, October/November 1969, November 1975.

B-14 Bureau of Business and Economic Research. "Nevada Population Estimates - 1974 and 1975"; "Nevada Population Projections"; "Methodology"; "Nevada Population by Counties - 1970-1974"; Reno: University of Nevada.

B-15 Bureau of Business and Economic Research. Nevada's Economic Resources, Report #3, (A. J. Dahl), Reno: University of Nevada.

B-16 BBNS. North Reno Intercepting Sewer Preliminary Design and Master Plan Report, September 1965.

B-17 Buoy, L. J. A Continued Study of Benthic Macro-Invertebrates in the Truckee River, Nevada, unpublished Masters Thesis, Reno: University of Nevada, 1968.

B-18 Bateman, R. L. and R. B. Scheibach. Evaluation of Geothermal Activity in the Truckee Meadows, Washoe County, Nevada, Nevada Bureau of Mines & Geology Report 25, 1975.

B-19 Bingler, E. C. Guidebook to the Quaternary Geology Along the Western Flank of the Truckee Meadows, Washoe County, Nevada, Nevada Bureau of Mines & Geology Report 22, 1975.

B-20 Birkeland, P. W. "Pleistocene Volcanism and Deformation of the Truckee Area, North of Lake Tahoe, California", Geological Society of America Bulletin, 74:1453-1464, 1963.

B-21 Bonham, H. F. and E. C. Bingler. Geologic Map of the Reno Quadrangle, Nevada Bureau of Mines & Geology Environmental Service, Reno Folio, 1973.

B-22 Bonham, H. F. and K. G. Papke. Geology and Mineral Deposits of Washoe and Storey Counties, Nevada, Nevada Bureau of Mines & Geology Bulletin 70, 1969.

B-23 Butcher, W. S., V. L. Gupta, J. W. Fondham and R. E. Miller. Planning and Management of Truckee River Flow System, Reno: Center for Water Resources Research, Desert Research Institute, University of Nevada, 1969.

B-24 Bolt, B. and Newman. Noise from Construction Equipment and Operation Building Equipment, and Home Appliances, EPA, December 1971.

B-25 Breese, C. Washoe County District Health Department, Personal Communication, May 11, 1976.

B-26 Brungs, W. A. "Effects of Wastewater Chlorination on Freshwater Aquatic Life", Journal Water Pollution Control Federation, 48 Annual Conference, 1975.

B-27 Brown, R. E. "Significance of Trace Metals and Nitrates in Sludge Soils", Journal Water Pollution Control Federation, 47(12):2863-2874, 1975.

B-28 Bureau of Business and Economics Research. On the Use of Regression Method in Estimating Regional Population, Report #15, Reno: University of Nevada, 1974.

C-1 Conger, T. A. Open Space Plan and Open Space Program for Washoe Council of Governments, Reno: Sharp, Kraeter and Associates, December 1974.

C-2 Chu, S. and B. Wofford. An Econometric Model for the State of Nevada, Bureau of Business and Economic Research, Research Report #12, Reno: University of Nevada, December 1974.

C-3 Census, Bureau of the. Census Tracts, Reno SMSA, Washington, D.C.: U. S. Department of Commerce, 1970.

C-4 Census, Bureau of the. Metropolitan Housing Characteristics, Reno SMSA, Washington, D.C.: U. S. Department of Commerce, 1970.

C-5 Census, Bureau of the. Block Statistics, Reno Urbanized Area, Washington, D.C.: U. S. Department of Commerce, 1970.

C-6 Census, Bureau of the. County Business Patterns, Washington, D.C.: U. S. Department of Commerce, 1973.

C-7 Census, Bureau of the. Detailed Housing Statistics, Nevada, Washington, D.C.: U. S. Department of Commerce, 1970.

C-8 Census, Bureau of the. General Population Statistics, Nevada, Washington, D.C.: U. S. Department of Commerce, 1970.

C-9 Census, Bureau of the. 1972 Census of Manufacturers, Nevada, Washington, D.C.: U. S. Department of Commerce.

C-10 Census, Bureau of the. 1972 Census of Retail Trade, Washington, D.C.: U. S. Department of Commerce.

C-11 Census, Bureau of the. 1972 Census of Wholesale Trade, Washington, D.C.: U. S. Department of Commerce.

C-12 Census, Bureau of the. 1972 Census of Selected Service Industries, Washington, D.C.: U. S. Department of Commerce.

C-13 Census, Bureau of the. Number of Inhabitants, 1970, Washington, D.C.: U. S. Department of Commerce.

C-14 Census, Bureau of the. General Social and Economic Characteristics, Nevada, Washington, D.C.: U. S. Department of Commerce, 1970.

C-15 Census, Bureau of the. Detailed Characteristics, Nevada, Washington, D.C.: U. S. Department of Commerce, 1970.

C-16 Census, Bureau of the. General Housing Characteristics, Nevada, Washington, D.C.: U. S. Department of Commerce, 1970.

C-17 Conservation of Natural Resources, Department of. Nevada's Environmental Quality, December 1973.

C-18 Census, Bureau of. Regular Employment by Industry, Washington, D.C.: U. S. Department of Commerce.

C-19 Census, Bureau of. Statistical Abstracts of the U. S., Washington, D.C.: U. S. Department of Commerce, 1974.

C-20 Census, Bureau of. Census of Population, 1950: Characteristics of the Population, Washington, D.C.: U. S. Department of Commerce.

C-21 Commerce, Department of. Series E Income Projections for ECON Area 161 - Nevada Part, BEA, READ, Washington, D.C.: U. S. GPO.

C-22 Commerce, Department of, Environmental Science Services Administration. Local Climatological Data: Annual Summary with Comparative Data, 1970, Reno, Nevada, 1974.

C-23 Crippen, J. R. and B. R. Pavelka. The Lake Tahoe Basin, California-Nevada, USGS Water Supply Paper, 1972.

C-24 Cohen, P. and O. J. Loeltz. Evaluation of Hydrogeology and Hydrogeochemistry of Truckee Meadows Area, Washoe County, Nevada, USGS Water Supply Paper 1779-S, 1964.

C-25 Cohen, P. Source of Sulphate in Ground Water of the Truckee Meadows Area, Nevada, U. S. Geological Survey Professional Paper 450-C, pp. 131-132, 1962.

C-26 Cooley, R. L. and F. A. Spane. Hydrogeologic Effects of a Gravel Pit Operation Near East 2nd Street and Kietzke Lane, Reno, Nevada, Reno: Center for Water Resources Research, Desert Research Institute Center, University of Nevada, Project Report Number 22, 1973.

C-27 Cooley, R. L., J. W. Fordham and J. A. Westphal. Hydrology of Truckee Meadows, Nevada, Reno: Center for Water Resources Research, Desert Research Institute, University of Nevada, Project Report Number 15, 1971.

C-28 Cordova, T. Active Faults in Quaternary Alluvium, and Seismic Regionalization in a Portion of the Mount Rose Quadrangle, Nevada, Masters Thesis, Reno: University of Nevada, 1969.

C-29 Cooley, R. L., J. W. Fordham and J. A. Westphal. Hydrology of Truckee Meadows, Nevada, Reno: Center for Water Resources Research, Desert Research Institute, University of Nevada, Project Report Number 15, 1971.

C-30 Commerce, U. S. Department of, Environmental Science Services Administration, Environmental Data Service. "Climatography of the United States", Series 82, Dicennial Census of the United States Climate - Summary of Hourly Observations, 1951-1960, Washington, D.C.

C-31 Crites, R. W. and C. E. Pound. "Land Treatment of Municipal Wastewater", Environmental Science and Technology, 10(6):548-551, 1976.

C-32 Commerce, Department of. Projections 1950-2020 Economic Activity in the U. S., BEA, READ, Washington, D.C.: U. S. GPO, 1972.

D-1 Desert Research Institute. Effect of Quality Factors on Water Based Recreation in Western Nevada, G. A. Myles, Reno: Center for Water Resources Research, University of Nevada, February 1970.

D-2 Doering, F. Climatologist, Personal Communication, National Climatic Center, Asheville, NC, December 3, 1975.

D-3 Desert Research Institute. Annual Report, Reno: Center for Water Resources Research, University of Nevada, 1973-1974.

D-4 Desert Research Institute, Personal Communication with David L. Koch, Reno: Center for Water Resources Research, University of Nevada, 1975.

D-5 Desert Research Institute. Computer Print-out of Water Quality Data for the Truckee River, January 1968 - January 1975, Reno: Center for Water Resources Research, University of Nevada, December 22, 1975.

D-6 Dodge, M. C. and J. J. Bufalini. The Role of Carbon Monoxide in Polluted Atmospheres, EPA.

D-7 Douglas, B. M. and A. Ryall. Return Periods for Rock Acceleration in Western Nevada, unpublished report.

D-8 Dotson, G. K. "Some Constraints of Spreading Sewage Sludge on Cropland", Wastewater Resource Manual, 1975.

D-9 Davis, E. Personal Communication, Operator of Reno JWPCP, July 1976.

D-10 Divine, J. Executive Vice President, California Independent Oil Marketers Association, Personal Communication, August 23, 1976.

E-1 Environmental Protection Agency. Manual For Preparation of EIS for Wastewater Treatment Works Facilities Plans and 208 Area Wide Waste Treatment Management Plan, July 1974.

E-2 Environmental Protection Agency. Final Environmental Impact Statement for North Lake Tahoe - Truckee River Basin, Wastewater Treatment and Conveyance System, F-EPA-24005-CA, September 1974.

E-3 Environmental Protection Agency. Draft EIS Las Vegas Wash/Bay Pollution Abatement Project (Sample Only), October 1974.

E-4 Environmental Protection Agency. Final Regulations, Preparation of EIS, FR40-72.

E-5 Environmental Protection Agency. Revision of Part, Grant Regulations and Procedures, FR40-90, May 1975.

E-6 Environmental Protection Agency. Minimum Standards, Procurement, EPA Grants, FR-40-91, May 1975.

E-7 Environmental Protection Agency. "Issue Paper", letter to Mr. R. Oldland, City Manager of Reno, June 1975.

E-8 Engineers, Corps of. Flood Plain Information, Truckee River; Reno-Sparks-Truckee Meadows, Nevada, Sacramento: Department of Army, Sacramento District for the Regional Planning Commission of Reno, Sparks and Washoe County, October 1975.

E-9 Environmental Protection Agency. Draft Outline for Secondary Impact Evaluation of Environmental Impact Statements for Wastewater Treatment Systems (201); Air Quality Maintenance Areas Only, (St. Louis) Region II, December 11, 1975.

E-10 Employment Security Department, State of Nevada. Semi-Annual Area Manpower Review, Reno SMSA, Vol. XIV, E. B. Cobb, Fall, 1975.

E-11 Employment Security Department, State of Nevada. Education, Manpower and Economy Data for Nevada, May 1973.

E-12 Employment Security Department, State of Nevada. Manpower Horizons for the Soaring Seventies, July 1969.

E-13 Environmental Council. The Quality of the Environment, Final Report to Governor Mike O'Callaghan, January 1973.

E-14 Employment Security Department, State of Nevada. Manpower Horizons, '75, July 1968.

E-15 Environmental Protection Agency. East Bay Dischargers Authority, Water Quality Management Program Phase I Project EIS, December 1975.

E-16 Employment Security Department, State of Nevada. Manpower Report, November 1975; December 1975.

E-17 Environmental Protection Agency. Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents, EPA-670/4-73-001, 1973.

E-18 Environmental Health, Nevada Bureau of. Water Quality Survey of Steamboat Creek, February 1974.

E-19 Environmental Protection Agency. Computer Printouts, period of record 1966-75.

E-20 Environmental Protection Agency. Process Design Manual for Sludge Treatment and Disposal, EPA 625/1-74-006, Washington, D.C., October 1974.

E-21 Environmental Protection Agency. Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities , 17090 DAN, October 1971.

E-22 Environmental Protection Agency. Process Design Manual for Suspended Solids Removal, EPA 625/1-75-003a, Washington, D.C., January 1975.

E-23 Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, 2nd Edition, Supplement No. 1, July 1973.

E-24 Environmental Protection Agency. National Interim Primary Drinking Water Regulations, 40 CFR 141:40 FR 59565, December 24, 1975.

E-25 Ewing, B. B. and R. I. Dick. "Disposal Sludge on Land", Water Quality Improvement by Physical and Chemical Processes, Austin: University of Texas Press, 1970.

E-26 Environmental Protection Agency, Office of Research and Development. Influences of Wastewater Management on Land Use: Tahoe Basin, 1950-1972, EPA 600/5-74-019, Washington, D.C., October 1974.

E-27 Environmental Protection Agency, Office of Research and Development. Water Quality Criteria, 1972, EPA R3/73-033, March 1973.

E-28 Environmental Protection Agency, Office of Water Program Operations. Evaluation of Land Application Systems, EPA 430/9-75-001, Washington, D.C., March 1975.

E-29 Environmental Protection Agency. Air Pollution Aspects of Sludge Incineration, EPA Technology Transfer Seminar Publication, June 1975.

E-30 Environmental Protection Agency. Sewage Sludge Incineration Task Force, February 1970.

E-31 Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards. "Designated Air Quality Maintenance Areas", Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 14 , Research Triangle Park, December 1975.

E-32 Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards. "Plan Preparation", Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 2 , Research Triangle Park, July 1974.

E-33 Environmental Protection Agency, Office of Air and Waste Management. Compilation of Air Pollutant Emission Factors, Supplement No. 5, 2nd edition, Research Triangle Park, April 1975.

E-34 Environmental Protection Agency. Water Quality Management Planning for Urban Runoff, EPA 440/9-75-004, 1974.

E-35 Engineers, U. S. Army Corps of. Wastewater Management by Disposal on the Land, Special Report 171, Hanover, NH: Cold Regions Research and Engineering Laboratory, 1972.

E-36 Environmental Quality, Coordinating Committee. Proceedings of the Joint Conference on Recycling Municipal Sludges and Effluents on Land, Champaign, IL: NTIS Pub. No. 227106, July 9-13, 1973.

E-37 Engineering News Record, 196(26), June 24, 1976 and 197(2), July 8, 1976.

E-38 Environment Reporter, Federal Laws, Clean Air Act, Technical Amendments, PL 93-319, p. 71:1105-1105, 1974.

E-39 Environmental Protection Agency. Control of Photochemical Oxidants - Technical Basis and Implication of Recent Findings, Research Triangle Park: Office of Air Quality Planning and Standards, July 1975.

E-40 Environmental Protection Agency. Quality Criteria for Water (Pre-publication copy), Washington, D.C., 1976.

E-41 Environmental Protection Agency, Office of Air and Waste Management. Transportation Controls to Reduce Automobile Use and Improve Air Quality in Cities Washington, D.C., November 1974.

E-42 Environmental Protection Agency, Office of Air and Water Programs. Transportation Control Strategy Development for the Metropolitan Los Angeles Region, Research Triangle Park, NC, December 1972.

E-43 Environmental Protection Agency, Office of Air and Waste Management. "Control Strategies", Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 3, Research Triangle Park, NC, July 1974.

E-44 Environmental Protection Agency. "Investigation of Fugitive Dust", Source Emissions, Vol. 1, Research Triangle Park, NC, June 1974.

F-1 First National Bank of Nevada. Nevada Review, 4th Quarter 1972, 3rd Quarter 1973, 3rd Quarter 1974, 3rd Quarter 1975 (2), 4th Quarter 1975, Update 1st 1976.

F-2 Fellows, D., J. R. Garrett and G. Link. Nevada Economic Profile, Reno: Bureau of Land Management, Nevada, Division of Agriculture and Resource Economics, Fleischmann College of Agriculture, University of Nevada, June 1974.

F-3 Feibusch, H. EIR on Route 395, U. S. Federal Highway Administration and Nevada Department of Highways, April 1975.

F-4 Forest Service (Tahoe and Toiyabe National Forest). Truckee-Little Truckee Rivers Planning Unit Draft Environmental Statement, U. S. Department of Agriculture, January 1976.

F-5 Federal Aviation Agency. Noise Contours Map and letter dated January 1, 1971 to City of Reno.

F-6 Fish and Game Department, Nevada. Job Progress Report F-20-11 (Job 107), 1974.

F-7 Fish and Wildlife Service, U. S. Personal Communication with R. D. Ringo, 1975.

F-8 Fish and Game Department, Nevada. Job Progress Report, F-20-11 (Job 101), 1975.

F-9 Fish and Game Department, Nevada. Personal Communication with Dale Lockhard, 1975.

F-10 Fish and Game Department, Nevada. Personal Communication with Robert Sumner, 1976.

F-11 Fish and Game Commission, Nevada. Report of Field Survey, Truckee River, Reno, NV, 1955.

F-12 Fish and Game Department, Nevada. Personal Communication with Robert Sumner, January 1976.

F-13 Faith, W. L. and A. A. Atkinson. Air Pollution, New York: Wiles and Sons, 1972.

F-14 Federal Register. Vol. 41, No. 134, July 12, 1976.

F-15 Federal Register. March 17, 1976.

G-1 Geological Survey, U. S. Reno Topo Relief Map.

G-2 Geological Survey, U. S. USGS 7-1/2 and 15 minutes Quad Sheets of Study Area.

G-3 Geological Survey, U. S. Water Resources - Reconnaissance Series Report 57; A Brief Water Resources Appraisal of the Truckee River Basin, Western Nevada, Washington, D.C.: Department of Interior and Nevada Department of Conservation and Natural Resources, Division of Water Resources, 1973.

G-4 Geological Survey, U. S. Water Resources Data for Nevada, Washington, D.C.: Department of Interior and Nevada Department of Conservation and Natural Resources, Division of Water Resources, 1974, 1975.

G-5 Guyton, W. F. and Associates. Groundwater Conditions in Spanish Springs Valley, Nevada, Reno: Sierra Pacific Power Company, June 1964.

G-6 Geological Survey, U. S. Water Resources Data for Nevada, Reports for Water Years 1962 to 1974.

G-7 Glancy, P. A., A. S. Van DenBurgh and S. M. Born. "Runoff, Erosion, and Solutes in the Lower Truckee River, Nevada, During 1969", Water Resources Bulletin, 8(6):1157, December, 1972.

G-8 Gresham, L. Personal Communication. EPA Region IX, San Francisco, CA, July 23, 1976.

H-1 Highways, Nevada State Department of. Truckee Meadows Area, Urban Transportation Study, Vol. II, 1964.

H-2 Highways, Nevada State Department of. Truckee Meadows Area, Urban Transportation Study, Vol. IV, 1964.

H-3 Highways, Nevada State Department of. Truckee Meadows Area Urban Transportation Study, Vol. I, 1964.

H-4 Highways, Nevada State Department of. Truckee Meadows Area Urban Transportation Study, Vol. III, 1964.

H-5 Highways, Nevada State Department of. 1974 Annual Traffic Report, Planning Survey Division and U. S. Department of Transportation, FHA.

H-6 Highways, Nevada State Department of. "Traffic (Analysis) Zones", Washoe County Area Transportation Study, 1973.

H-7 Highways, Nevada State Department of. Truckee Meadows Basin Air Quality Study, April 1976.

H-8 Harris, E. E. Reconnaissance Bathymetry of Pyramid Lake, Washoe County, Nevada, USGS, 1970.

H-9 Health Department, Washoe County District. Washoe County Environmental Protection Annual Report, 1972, 1973 and 1974.

H-10 Health Department, Washoe County District. Personal Communication with C. Breese, Reno, NV, December 5, 1974.

H-11 Health Department, Washoe County District. Air Pollutant Source Emissions Inventory, Reno, Nevada, 1973.

H-12 Holzworth, G. C. Mixing Heights, Wind Speeds and Potential for Urban Air Pollution throughout the Contiguous United States, USEPA, January 1972.

H-13 Housing and Urban Development, Department of. FIA Flood Hazard Boundary Maps, Washoe County, December 1974.

H-14 Housing and Urban Development, Department of. Noise Assessment Guidelines, Washington, D.C., August 1971.

H-15 Hyde, H. C. "Utilization of Wastewater Sludge for Agricultural Soil Enrichment", Journal of the Water Pollution Control Federation, 48(1), January 1976.

H-16 Hinesly, T. D., et al. Agricultural Benefits and Environmental Changes Resulting from the Use of Digested Sewage Sludge on Field Crops, Annual Report, University of Illinois and City of Chicago, EPA Grant DO 1-U1-00080, unpublished, 1972.

H-17 Health Department, Washoe County District. Personal Communication, March 1976.

H-18 Health Department, Washoe County District. 1975 Air Quality Data, January 30, 1976.

H-19 Health, District Board of. Air Pollution Control Regulations, Reno-Sparks & Washoe County, February 1, 1973.

H-20 Highways, Nevada State Department of. Status Report 1975.

H-21 Highways, Nevada State Department of. 1975 Annual Traffic Report, Planning Survey Division and U. S. Department of Transportation, FHA.

H-22 Hopkins, S. W. Life Among the Paiutes, New York: G. P. Putnam & Sons, 1883.

H-23 Harner, N. S. Indians of Coo-yu-ee Pah (Pyramid Lake), Sparks, NV: Dave's Printing and Publishing, 1974.

I-1 Interior, U. S. Department of. Draft Environmental Statement of the Proposed Operating Criteria for the Lower Truckee-Lower Carson River Basins, May 30, 1975.

I-2 Interior, U. S. Department of. U. S. List of Endangered Fauna, May 1974.

I-3 Interior, U. S. Department of. Unpublished data from Geological Survey Records, January 1976.

I-4 Interior, U. S. Department of. Results of sample analysis (samples taken February 9, 1976), Reno: Bureau of Mines.

I-5 Illinois Advisory Committee on Sludge and Wastewater Utilization on Agriculture Land, James F. Frank, Chairman, February 1975.

I-6 Illinois EPA. Air Pollution Control in Illinois, Springfield, IL.

J-1 Johnson, V. K. et al. Ecological Survey of the Lower Truckee River, 1971, Pyramid Lake Interagency Review Team of the Lower Truckee River, 1971.

K-1 Kennedy Engineers, Inc. Facilities Plan for Expansion of the Reno/Sparks Joint Water Pollution Control Plant, City of Reno, August 1975.

K-2 Kennedy Engineers, Inc. Cost-Effectiveness of Phased Expansion, JWPCF, Letter to R. H. Oldland, City Manager, Reno, NV, June 10, 1976.

K-3 Koch, D. L. and D. Klebenow. Final Report on Fenced Enclosures on the Lower Truckee River, 1974.

K-4 Klieforth, H. and G. Cox. Weather, Climate and Vegetation, prepared for Washoe County Blue Ribbon Task Force on Growth and Development, Physical Constraints Committee, December 20, 1973.

K-5 Koch, D. L., L. Hoffman and J. L. Mahoney. Pyramid Lake: Zooplankton Distribution and Blooms of the Blue Green Algal Nodularia Spumigena, Reno: Center for Water Resources Research, Desert Research Institute, University of Nevada, January 1976.

K-6 Kaiser Engineers. Water Quality Survey of the Truckee River, Vols. 1 and 2, California Water Resources Control Board, June 1973.

K-7 Kroger, W. "Motorists Face Hazy Conditions", Reno Journal, January 27, 1971.

K-8 Koch, D. L. and J. L. Hainline. Benthic Macro-Invertebrate Populations in the Truckee River, Nevada-California with Reference to River Flow and Water Quality, Project Report No. 41, February 1976.

L-1 Livingston and Blayney, et al. Reno Downtown Development Plan: Project Renovation, August 1969.

L-2 Bureau of Land Management. Draft Regional Environmental Analysis Record: Geothermal/Oil and Gas Leasing, Pyramid Area, Carson City District, Nevada, (Nevada State Library #75800034).

L-3 Labor Statistics, Bureau of. Personal Communication, San Francisco, CA, December 9, 1975.

L-4 LaRivers, I. A Listing of Reptiles of the Truckee Meadows (Reno Area), Nevada, Verdi, NV: Biological Society of Nevada.

L-5 LaRivers, I. Fishes and Fisheries of Nevada, Carson City, NV: Nevada Fish and Game Department, 1962.

L-6 Liao, P. B. and M. J. Pilat. "Air Pollutant Emissions from Fluidized Bed Sewage Sludge Incinerators", Water and Sewage Works, February 1972.

L-7 Landsberg, H. E., Institute of Fluid Dynamics and Applied Mathematics, University of Maryland. Testimony before the Subcommittee on the Environment and the Atmosphere of the Committee on Science and Technology, U. S. House of Representatives, 1975.

M-1 Myers, L. H. The Effects of Greater Reno Area Pollutants on the Benthic Macro-Invertebrates of the Truckee River, Nevada, unpublished Masters Thesis, Reno: University of Nevada, 1967.

M-2 McBrayer, J. W. and R. D. Ringo. Egg and Alevin Survival and General Spawning Conditions for Lahontan Cutthroat Trout in the Lower Truckee River During 1974, Reno: U. S. Fish and Wildlife Service, July 1975.

M-3 Mock, R. G. Correlation of Land Surfaces in the Truckee River Valley between Reno and Verdi, Nevada, Masters Thesis, Reno: University of Nevada.

M-4 Morris, R. J., C. M. Skau and V. Vitale. A Preliminary Study of the Relationships Between Stream Water Quality and Watershed Characteristics for the Truckee River, Miscellaneous Report No. 7, Reno: Center for Water Resource Research, Desert Research Institute, University of Nevada, 1970.

M-5 McKeever, J. R. (ed.). The Community Builders Handbook, Washington, D.C.: Urban Land Institute, p. 131N; citing J. H. Niedercorn and E. F. R. Herle, Recent Land-Use Trends, 1968.

M-6 Morris, R. J., C. M., Skau and V. Vitale. Geology of Parts of Wasdworth and Churchill Butte Quadrangles, Nevada, Nevada Bureau of Mines and Geology Bulletin, Vol. 7, 1969.

M-7 Mahannah, C. N., et al. Western Nevada Water Controversy, Cooperative Extension Service, Coll. Agriculture, No. B34, Reno: University of Nevada, 1975.

M-8 Mackenthun, K. M. The Practice of Water Pollution Biology, U.S.D.I., Federal WPCA, Division Technical Support, 1969.

M-9 McGauhey, P. H. "Septic Tanks and Their Effects on the Environment", Water Pollution Control in Low Density Areas, Hanover, NH: University Press of New England, 1975.

M-10 Metropolitan Sanitary District of Greater Chicago, Department of Research and Development. USEPA Guidelines on Sludge Utilization and Disposal - A Review of Its Impact Upon Municipal Wastewater Treatment Agencies, Report No. 75-20, October 1975.

M-11 McNeely, J. G., Jr. and W. F. Kelly. Unpublished research, Reno: University of Nevada, 1969-1969.

N-1 Nevada Transit Company. Bus Routes and Areas, Schedule No. 4, October 1975.

N-2 Nolte, G. S. & Associates. Telephone Survey, February 1976.

N-3 Nolte, G. S. & Associates. Telephone Survey, January 1976.

N-4 Nolte, G. S. & Associates. Telephone Survey, January 1976.

N-5 Nevada State Journal. "Truckee River Water Rights Trial to Resume", Reno, NV, January 6, 1976.

N-6 National Air Data Bank, Research Triangle Park, NC, May 17, 1976.

N-7 Nevada Historical Review. Appendix 2, "Notes on the Northern Paiute", Sparks, NV: Dave's Printing and Publishing, Spring 1974.

O-1 O'Brien, J. Memos to J. W. Brown, various agency contacts.

O-2 Outdoor Recreation, Bureau of. Pyramid Lake Recreation Study Report, Department of Interior, July 1971.

O-3 O'Connell, R. L., N. E. Thomas, P. J. Godsil and C. R. Hirth. Report of Survey of the Truckee River, U. S. Department of Health, Education and Welfare, Public Health Service, August 1963.

O-4 O'Connell, R. L., J. R. Geckler, R. M. Clark, J. B. Cohen and C. R. Hirth. Report of Survey of the Truckee River, U. S. Department of Health, Education and Welfare, Public Health Service, July 1962.

P-1 Pugh Nolte and Associates for the U. S. Army Engineer District Corps of Engineers. Stereo Orthophoto, Sacramento, CA, 1968.

P-2 Pyramid Lake Task Force. Pyramid Lake Task Force Final Report.

P-3 Park Commission of Washoe County. A Plan for Washoe County, Master Plan Report No. 7: Parks, Recreation and Open Space for Washoe County, April 1962.

P-4 Pyramid Lake Paiute Tribe. Suit #R-2987BRT, U. S. District Court, Nevada.

P-5 Peirano, L. E. Low Cost Phosphorous Removal, presented at WPCA Conference, Miami Beach, FL, October 1975.

P-6 Powell, G. M. Design Seminar for Land Treatment of Municipal Wastewater Effluents, USEPA, Design Factors Part II, September 1975.

P-7 Phelps, E. B. Stream Sanitation, New York: John Wiley and Sons, Inc., 1944.

P-8 PEDCo. Nevada Particulate Control Study for AWMA's, Task C Report, Emissions Inventory and Emissions Projections, Cincinnati, OH, May 1976.

R-1 Reno, City of. Contract, First Supplemental Agreement, Memo of Understanding, as Amended.

R-2 Reno, City of. Request for Proposal, 1975.

R-3 Reno, City of. Engineering Report for Lawton Interceptor, October 12, 1972, revised June 28, 1975.

R-4 Reno, City of. A General Development Plan for the City of Reno, Nevada, 1970.

R-5 Regional Planning Commission of Reno, Sparks and Washoe County. Regional Planning Report: 1974, February 1975.

R-6 Regional Planning Commission of Reno, Sparks and Washoe County. A Conservation Plan; A Population Plan, City of Sparks, Nevada, June 1975.

R-7 Regional Planning Commission of Reno, Sparks and Washoe County. A Conservation Plan; A Population Plan, City of Reno, Nevada, June 1975.

R-8 Regional Planning Commission of Reno, Sparks and Washoe County. Community Design Handbook, October 1974.

R-9 Reno Evening Gazette-Nevada State Journal. "Truckee Meadows Transportation Study, 1973-74 ANNUAL REPORT - Nevada Looks Ahead", February 22, 1975.

R-10 Regional Planning Commission of Reno, Sparks and Washoe County. Lemon Valley Comprehensive Plan, Phase I - Inventory and Analysis, February 1974.

R-11 Regional Planning Commission of Reno, Sparks and Washoe County, in Conjunction with Area COG. "Public Utilities - Water, Sanitary Sewer, Storm Drainage", in A General Plan Washoe County, Nevada Standard Metropolitan Statistical Area, November 1972.

R-12 Regional Planning Commission of Reno, Sparks and Washoe County. "Regional Planning Commission Comprehensive Planning Process" (S. Bradhurst), "TAZ Land Use Summary".

R-13 Reno Chamber of Commerce. Statistical Profile: Reno, Sparks, Washoe County - 1973-1974.

R-14 Reno Chamber of Commerce. Statistical Profile: Reno, Sparks, Washoe County - 1974-1975.

R-15 Regional Planning Commission of Reno, Sparks and Washoe County. Land Ownership Map and Statistical Tabulation, 1975.

R-16 Real Estate Research Corp. Economic Survey and Analysis, Reno, Nevada, 1968.

R-17 Regional Planning Commission of Reno, Sparks and Washoe County. Proposed Conservation & Population Plan; Reno, Sparks and Washoe County, March 3, 1976.

R-18 Regional Planning Commission of Reno, Sparks and Washoe County, 1/7 Map 2, Principal Water Features of Washoe County.

2/7 Map 3, Truckee Meadows Principal Water Features and Facilities.

3/7 Map 4, Current and Potential Area of Reno and Sparks.

4/7 Map 5, Bureau of Land Management Planning Districts.

5/7 Map 6, Washoe County 1970 Population Distribution and Density.

6/7 Map 9, Potential Urban Development Area.

7/7 Map 10, Public Ownership in Potential Urban.

R-19 Rush, E. E. Bathymetric Reconnaissance of Lake Tahoe, Nevada and California, Report No. 17, USGS Water Resources Information Series, 1973.

R-20 Rush, F. E. and P. A. Glancy. Water Resources Appraisal of the Warm Springs - Lemmon Valley Area, Washoe County Nevada, Report No. 43 of the Water Resources Reconnaissance Series, U. S. Department of the Interior, Geologic Survey, November 1967.

R-21 Reclamation, Bureau of, U. S. Department of the Interior. Draft Environmental Statement Authorized Marble Bluff Dam and Pyramid Lake Fishway, Washoe County, Nevada, June 8, 1973.

R-22 Ratliff, J. M. Remote Sensing Evaluations of Phreatophytic Vegetation in Nevada, Masters Thesis, Reno: University of Nevada, 1972.

R-23 Ryckman/Edgerley/Tomlinson & Associates, Inc. Field survey of the Lower Truckee River Basin-Pyramid Lake area, December 1975.

R-24 Ringo, R. D. A Survey of Truckee River Fish Passage Problems with Emphasis on Lahontan Cutthroat Trout, a report to the Lower Truckee River Interagency Fishery Evaluation Team, 1975.

R-25 Regional Planning Commission. A Conservation Plan, A Population Plan: Reno, Sparks and Washoe County, June 1975.

R-26 Reno Journal. "Reno Air Pollution Getting Steadily Worse", January 21, 1976.

R-27 Rush, F. E. Water Resources Appraisal of the Warm Springs - Lemmon Valley Area, Washoe County, Nevada, Water Resources Reconnaissance Series Report No. 43, State of Nevada Department of Conservation and Natural Resources, Division of Water Resources, November 1967.

R-28 Reno, City of. Lawton to Keystone Sewer Line Crossings of I-80, April 1966.

R-29 Reno, City of. Airport Managers Office, Personal Communication, February 1976.

R-30 Reno/Sparks Joint Water Pollution Control Plant Records, July 1974 through November 1975.

R-31 Ryckman/Edgerley/Tomlinson & Associates, Inc.

R-32 Ryckman/Edgerley/Tomlinson & Associates, Inc. JWPCP - Prediction, water quality parameters for concepts with Reno-Sparks growth and no growth, 1976

R-33 "Recycling", Proceedings of the Joint Conference on Municipal Sludges and Effluents on Land, Champaign, IL, July 9-13, 1973.

R-34 Rhoads, R. G. Recommended Fugitive Dust Policy, Chief Standards Implementation Branch, EPA, March 12, 1976.

S-1 SEA, Inc. Reno Cross-Town Interceptor, October 30, 1975, Reno, early 1976, including Appendices A-E.

S-2 Sierra Pacific Power Company. First Progress Report and Management Proposal, Pyramid Lake Task Force, March 1975.

S-3 Sparks, City of. A General Plan of Development for the City of Sparks, Nevada, 1970.

S-4 Sierra Pacific Power Company. Customer and Energy History and Forecast Data, 1975.

S-5 State Engineers Office, Division of Agriculture and Resource Economics, Fleischmann College of Agriculture. "Water Related Recreation in Nevada, Present and Future", Water for Nevada #7, Reno: University of Nevada, December 1973.

S-6 State Engineers Office, Division of Agriculture and Resource Economics, Fleischmann College of Agriculture. "Forecasts for the Future Electric Energy", Water for Nevada #9, August 1974.

S-7 State Engineers Office, Division of Agriculture and Resource Economics, Fleischmann College of Agriculture. "Estimated Water Use in Nevada", Water for Nevada #2, January 1971.

S-8 State Engineers Office. "Water Legal and Administrative Aspects", Water for Nevada, Special Information Report Department of Conservation and Natural Resources, Division of Water Resources, September 1974.

S-9 State Engineers Office, Division of Agriculture and Resource Economics, Fleischmann College of Agriculture. "Water Supply for the Future in Southern Nevada", Water For Nevada, Special Planning Report Summary, January 1971, (Victor Hill Report).

S-10 Sierra Pacific Power Company. Statistical Report for Year 1974, 1975.

S-11 School District of Washoe County. Resources Handbook on Educational Statistics.

S-12 State Engineers Office, Division of Agriculture and Resource Economics. "Update of Victor Hill Report", Water for Nevada, Forecasts for the Future Populations #5, February 1973.

S-13 Sierra Pacific Power Company. Water System Study and Proposed System Improvements, 1971.

S-14 Sharp, Krater & Associates. Project Management System for Area-Wide Waste Treatment Management Plan, Section 208 of PL 92-500, January 1976.

S-15 Sparks, City of. City of Sparks Master Sewer Plan Map, Engineering Division, Public Works Department, August 1976.

S-16 Spink Corporation. City of Sparks, Feasibility Study for Spanish Spring Interceptor, December 1972.

S-17 Sierra Pacific Power Company. Water Use in Recent Years (1970-1975).

S-18 SEA, Inc. "Cost Effectiveness of Phased Expansion, Population Planning Documentation and Alternative Designs Discussion: Reno Cross-Town and Lawton-Verdi Sewer Interceptor", Letter to R. Sanford, Director of Public Works, City of Reno, July 8, 1976.

S-19 State Engineers Office, Division of Agriculture and Resource Economics, Fleishmann College of Agriculture. Water for Nevada #1, 1971.

S-20 State Engineers Office, Division of Agriculture and Resource Economics, Fleishmann College of Agriculture. "Forecasts for Future - Fish and Wildlife", Water for Nevada #6, September 1973.

S-21 Slemmons, D. B., J. I. Gimlett, et al. Earthquake Epicenter Map of Nevada, Air Force Office of Scientific Research, Technical Report No. 5, 1965.

S-22 Stemmons, D. B. Water and Related Land Resources, Central Lahontan Basin, Truckee River Subbasin, Nevada and California, Appendix I - Soils, Nevada Department of Conservation and Natural Resources and the U. S. Department of Agriculture, Forest Service, February 1970.

S-23 Sierra Pacific Power Company. Environmental Impact Statement for the North Valmy Station, 1976.

S-24 Stephens, R. Hydrochemistry of Truckee Meadows, Reno: University of Nevada, unpublished Masters Thesis, 1971.

S-25 State Engineers Office, Division of Agriculture and Resource Economics. "Nevada's Water Resources", Water for Nevada #3, 1971.

S-26 Sierra Pacific Power Company. Personal Communication, 1976.

S-27 Streeter, H. W. "The Role of Atmospheric Reaeration of Sewage-Polluted Streams", Trans. Amer. Soc. Civil Engr., 89:1355, 1926.

S-28 Sigler, W. F. Water Quality Analysis of Pyramid Lake, 1976.

S-29 Sport Fisheries and Wildlife, U. S. Bureau of. Job Progress Report, Pyramid Lake, F-20-11, 1975.

S-30 Stork, E. O. Preliminary Data on Exhaust Emissions for 1973-1975 Model Year Cars from the FY 1974 Surveillance Program, USEPA interagency correspondence to R. Strelow, April 21, 1976.

S-31 Shipp, R. F. and D. E. Baker. "Pennsylvania's Sewage Sludge Research and Extension Program", Compost Science, 16(2):6-8, 1975.

S-32 SEA, Inc. "Revised Facilities Plan Summary", Letter to R. Sanford, Director of Public Works, City of Reno, August 20, 1976.

S-33 SEA, Inc. "Revisions, Facilities Plan", Letter to R. Sanford, Director of Public Works, City of Reno, June 1, 1976.

T-1 Truckee Meadows Engineers. Proposal for Consulting Services, 1975.

T-2 Truckee Meadows Engineers. Reno Cross-Town Sewer Study, 1974.

T-3 Truckee Meadows Engineers. South Truckee Meadows Intercepting Sewer Preliminary Design and Master Plan, March 1966.

T-4 Truckee Meadows Engineers. Mill Street Intercepting Sewer Preliminary Design, November 1968.

T-5 Truckee Meadows Engineers. Report on Sanitary Sewer Master Plan for a Portion of Northwest Reno, May 1964.

T-6 Truckee Meadows Engineers. "Dickinson Road Interceptor Sewer", Construction Drawings, November 1966.

T-7 Truckee Meadows Engineers. "Peavine Mountain Interceptor Sewer, Phase II", Construction Drawings, February 1974.

T-8 Truckee Meadows Engineers. City of Reno Traffic Count Data, February 3, 1976.

T-9 Truckee Meadows Engineers. 1974 ADT Downtown Reno, update 1990 study, February 3, 1976.

T-10 Truckee Meadows Engineers. Traffic Count Data by JHK for Reno, February 3, 1976.

T-11 Truckee Meadows Engineers. Update of Truckee Meadows Urban Transportation Study, 1974-1975, Received April 6, 1976.

T-12 Thompson, G. A. and C. H. Sandburg. "Structural Significance of Gravity Surveys in the Virginia City - Mount Rose Area, Nevada and California", Geological Society American Bulletin, 69(10):1269-81, 1958.

T-13 Truckee Meadows Engineers, Inc. Sanitary Sewer Capacity Book for City of Reno.

T-14 Truckee Meadows Engineers, Inc. "Lawton's Sewer, Phase I, Line 42, As-builts", June 1970.

T-15 Truckee Meadows Engineers, Inc. "Lawton's Sewer, Phase II, Line 42, As-builts", April 1971.

T-16 Truckee Meadows Engineers, Inc. "Lawton's Sewer, Phase III, Line 42, As-builts", December 1973.

T-17 Thompson, Arnold & Associates, Inc., et al. Master Plan Report Reno National Airport, April 1976.

V-1 Van Denburgh, A. S., R. D. Lamke and J. L. Hughes. A Brief Water Resources Appraisal of the Truckee River Basin, Western Nevada, Water Resources - Reconnaissance Series Report No. 57, State of Nevada Department of Conservation and Natural Resources, Division of Water Resources, 1973.

W-1 Walters Engineering and Metcalf and Eddy. Unified HUD - EPA Areawide Water Quality Management Plan for Washoe County, November 1974.

W-2 Walters Engineering and Metcalf and Eddy. Unified HUD - EPA Water Quality Management Plan, Interim Report No. 2, May 1974; amended June 1974.

W-3 Water Resource Consulting Engineers and John Carollo Engineers for the City of Reno. Reno-Stead Wastewater Treatment Facilities, Environmental Assessment, 1973, August 1, 1975.

W-4 Water Resource Consulting Engineers and John Carollo Engineers for the City of Reno. Reno-Stead Wastewater Treatment Facilities, Project Report, 1973, September 1973.

W-5 Willson, S. R. Reno, Sparks, Sun Valley, Lemon Valley, Golden Valley and Surrounding Area, (Map: 1,000' scale), Reno, Nevada and Index.

W-6 Washoe COG. Housing Study-Phase I, Inventory and Analysis, 1975.

W-7 Walters Engineering. Project Report - Wastewater, Collection Treatment and Disposal Facilities for Sun Valley Water and Sanitation District, February 1975.

W-8 WCOG letter to J. W. Brown, March 22, 1976. EIS letter of intent.

W-9 Woodbury, W. V. The History and Present Status of the Biota of Anaho Island, Pyramid Lake, Nevada, Masters Thesis, Reno: University of Nevada, 1966.

W-10 Wheeler, S. S. The Desert Lake, Caldwell, Idaho, Caldwell, ID: The Claxton Printers, Ltd., 1968.

W-11 White, D. E. Hydrology, Activity and Heat Flow of the Steamboat Springs Thermal System, Washoe County, Nevada, U. S. Geological Survey Professional Paper 458-C, 1968.

W-12 Wheeler, S. The Desert Lake, Caldwell, ID: The Claxton Printers, Ltd., 1968.

W-13 Wright, B. Washoe County District Health Department, Personal Communication, October 18, 1976.

Y-1 Young, J. A. and R. A. Evans. Plant Ecology, Blue Ribbon Task Force, Physical Constraints Subcommittee, 1973.